A COMPARISON OF AMERICAN PAULIN SYSTEM AND WALLACE AND TIERNAN ALTIMETERS, AND A SURVEY OF PART OF THE CITY OF RENSSELAER, NEW YORK BY AERIAL PHOTOGRAPHS WITH THE USE OF ALTIMETERS

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Thesis
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A COMPARISON OF [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], AND A SURVEY OF PART OF THE CITY OF [illegible], THE [illegible] [illegible] [illegible] [illegible] THE USE OF [illegible].

A THESIS SUBMITTED TO THE FACULTY
OF RENSSELAER POLYTECHNIC INSTITUTE
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR DEGREE OF
BACHELOR OF CIVIL ENGINEERING

BY

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TROY, N.Y.
JUNE, [illegible]

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WE WISH TO EXPRESS APPRECIATION TO ALL THOSE WHO HAVE GIVEN US AID AND ADVICE IN OUR PROSECUTION OF THIS THESIS, AND ESPECIALLY DO WE THANK THE FOLLOWING; PROFESSOR H.O. SHARP, OF THE DEPARTMENT OF CIVIL ENGINEERING, RENSSELAER POLYTECHNIC INSTITUTE; AND INSTRUCTOR ROBERT PALMER, OF THE CIVIL ENGINEERING DEPARTMENT, RENSSELAER POLYTECHNIC INSTITUTE.

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INTRODUCTION

The use of altimeters in conjunction with aerial photographs offers broad possibilities in the mapping of large tracts of land by small parties at a minimum of cost. Since relatively little work has been done on this topic, our party accepted for its thesis subject a two-fold plan intended to test the suitability of this method of elevation determination both under laboratory and under field conditions.

The first phase consisted of a series of instrument observations to determine the effects of temperature and weather conditions on the various instruments and their different susceptibilities to change. These checks were followed by a number of elevation determinations employing the altimeter two base method on points of known elevation on the grounds of Rensselaer Polytechnic Institute. This work was intended to absolutely establish the accuracy of the instruments and of the general method for later contour plotting. Included in both phases was a comparison of the relative accuracies and sensitivities of altimeters manufactured by the Paulin Company and by Wallace and Tiernan.

For the second phase, with the use of aerial photographs, we plotted five foot interval contours by the two base method of a section of the town of Rensselaer, N.Y.,

this plot further intended to check and to substantiate the results achieved by Lieutenants Graves and Nicholson in a similar survey conducted in 1947 on the same area using the altimeter one base method.

PRELIMINARY COMPARISON

APPARATUS AND MATERIALS

The following equipment employed was the property of the Civil Engineering Department of Rensselaer Polytechnic Institute.

(a) Three Wallace and Tiernan 0-7000 feet altimeters, numbers 93,94 and 95.

(b) Level number 138.

(c) Level rod, stakes and miscellaneous surveying equipment.

The following equipment employed was the property of the American Paulin System and loaned to the Civil Engineering Department of Rensselaer Polytechnic Institute for the purpose of this comparison.

(a) Three American Paulin Altimeters,Model SA-1, -760 to plus 3,600 feet, numbers 56,75 and 91.

NOTES ON ALTIMETERS

I. Wallace and Tiernan Altimeters.

These are aneroid barometers of high sensitivity. This company makes two models: one with a range of 0-7000 feet and the other 0-15,000 feet. The instruments used were of the 0-7,000 feet model. Both models are graduated directly in feet and not inches or mm of pressure. The 0-7,000 model is graduated in ten foot intervals and can be read to the nearest foot.

II. American Paulin System.

The American Paulin System makes three models of aneroid altimeters: Model SA-1,-760 to plus 3,600 feet

graduated on two foot intervals; Model SA-2 graduated to 5 foot intervals and range of -900 to plus 9,700 feet; and Model SA-5 graduated to 10 foot intervals and range -500 to plus 14,500 feet. The Paulin Altimeters are somewhat different in reading from the Wallace and Tiernan. The Wallace and Tiernan pointer moves with a change of pressure and reads directly. In the Paulin as pressure changes the indicating pointer does not move, but rather a balance indicator moves away from the balance mark as pressure changes. To take a reading this balance indicator is moved in line with the balance mark by moving the pointer knob which also moves the pointer to the correct reading.

PRELIMINARY COMPARISON OF INSTRUMENTS

Before using the instruments in the field for measuring elevations for contour plotting, the instruments were compared for the following:

For both Wallace and Tiernan and Paulins- (a) Static time test to determine how the instruments vary with time and change in pressure,(b) Computation of difference in elevation between two bench marks using the one base method and (d) effect of an abrupt temperature change on the instruments.

For Paulins alone-(a) Accuracy of realigning and reading scale.

graduated on two foot intervals; Model 62-C graduated to 5 foot intervals and range of -600 to plus 9,700 feet; and Model 61-C graduated in 10 foot intervals and range -600 to plus 16,000 feet. The Paulin Altimeters are somewhat different in reading from the Wallace and Tiernan. The Wallace and Tiernan pointer moves with a change of pressure and reads directly. In the Paulin as pressure changes the indicating pointer does not move, but rather a balance indicator moves away from the balance mark as pressure changes. To take a reading this balance indicator is moved in line with the balance mark by moving the pointer knob which also moves the pointer to the correct reading.

PRELIMINARY COMPARISONS OF INSTRUMENTS

Before using the instruments in the field for measuring elevations for contour plotting, the instruments were compared for the following:

For both Wallace and Tiernan and Paulins- (a) Static time test to determine how the instruments vary with time and change in pressure, (b) Computation of differences in elevation between two bench marks using the one base method and (c) effect of an abrupt temperature change on the instruments.

For Paulins alone-(a) accuracy of realigning and reading knob.

STATIC TIME TEST

For this, all instruments were left in the instrument room of RPI at the same elevation. Thus all instruments were subjected to the same lighting conditions, temperature and pressure. At the start the scale of all instruments of each type were set at the same elevation. Then they were allowed to stand and readings taken at intervals to determine how the instruments were reacting to the change in pressure. The settings of the scales were changed from time to time to take in low and high scale readings. Each of the Wallace and Tiernan altimeters varied approximately the same throughout the scale. The variation could be taken care of by assuming a straight change without serious error in results. The results of the Paulins were not as good as those of the Wallace and Tiernans. Paulin numbers 56 and 75 remained together as time passed. However, Paulin number 91 acted erratic from the start. It was not consistent, as, one time it would be high and a few minutes later it would read low. No rule could be formulated for its correction.

ONE BASE METHOD ELEVATION CHECK

The Troy Building bench mark and a point 1.3 feet below bench mark T-42 at Troy railroad station were used. Difference in elevation was 189.2 feet. The bench mark at the Troy building was taken as the fixed base and then the

the difference between the two points computed from each instrument by the one base method. Results by the Paulin altimeters were about 9 feet high. Even though the results were high they were consistent between instruments. As the instruments are to be used in the field by the two base method the error will somewhat cancel out. The difference, as measured by the Wallace and Tiernans, was consistent between instruments and also within about 2 feet of the correct value.

EFFECT OF TEMPERATURE CHANGE

Here it was attempted to determine what effect, if any, a sudden large temperature change would have on the instruments. The altimeters were set together while in the instrument room. Then they were carried outside. The temperature difference was 40 degrees F. For about the first twenty minutes the Paulins were erratic and did not settle down together. The Wallace and Tiernans did not seem to be effected.

The above statements also apply when the instruments are brought into the heated building. In addition to subjecting all three instruments to the change simultaneously one would be preheated and then all three compared.

It seems that when the instruments are taken out into the field where there is as much as 30 degrees temperature difference at least 15 or 20 minutes must be allowed for the Paulins to acclimate. Preheating and precooling is thus necessary for the Paulins.

ACCURACY OF ALIGNING PAULIN ALTIMETERS

The purpose of this test was to determine within what limits the Paulin altimeters could be aligned and read.

Two instruments were placed in the same lighting conditions, pressure and temperature. The two instruments chosen had been reacting the same under atmospheric changes. Thus by using two instruments the change in pressure between readings could be taken into account. The procedure was then to take a series of simultaneous readings on the two instruments; moving pointers off and realigning for each reading.

For each instrument the successive readings were subtracted to find the change between readings. Then this difference was compared to the corresponding difference recorded by the other instrument. This comparison gave the diversity between any four readings of the scales. If the instruments could have been aligned and read exact this diversity would have been zero. As it was its greatest value was 2 feet. From that it can be concluded that the Paulin altimeters can be aligned and read to within one foot of the value indicated by the instrument.

In reading the Paulin altimeters care must be exercised to have the instruments level and shadows parallel with the balance indicator.

THE TEST

All instruments were in the instrument room of the Civil Engineering Department of Rensselaer Polytechnic Institute and at the same temperature and elevation.

PAULIN ALTIMETERS

TIME	No 56	No 91	No 75	COMMENTS
Feb 18,1445	800	800	800	
Feb 19,0900	742	738	743	Shadows and lighting conditions bad.
Feb 19,0948	754	755	755	Instruments moved to better lighting conditions.
Feb 19,1230	902	899	902	Before carrying outside ,where there is a temp. diff. of 30 degrees.
Feb 19,1430	1008	1019	994	After bringing inside and before allowing to warm up.
Feb 19,1440	992	1004	987	
Feb 19,1450	994	1004	992	
Feb 19,1455	998	1008	997	
Feb 20,1305	600	600	600	Instruments reset
Feb 23,0905	124	86	110	
Feb 23,0950	115	88	102	
Feb 23,1100	106	78	92	
Feb 23,1425	120	93	105	
Feb 24,1015	-45	-46	-39	
Feb 24,1012	500	500	500	Instruments reset and taken outside.Temperature diff. of 24 degrees F.
Feb 24,1023	501	500	502	
Feb 24,1025	502	500	502	
Feb 24,1030	503	502	501	
Feb 24,1035	510	507	504	
Feb 24,1040	519	516	510	

TIME TEST Con't.

TIME	No 56	No 91	No 75	COMMENTS
Feb 24,1045	524	527	514	
Feb 24,1050	533	540	524	
Feb 24,1055	532	544	523	
Feb 24,1100	533	544	522	
Feb 24,1105	524	547	520	
Feb 24,1106				Brought inside.
Feb 24,1110	542	555	522	
Feb 24,1115	543	559	522	
Feb 24,1120	545	560	529	
Feb 24,1125	545	559	530	
Feb 24,1130	540	553	527	
Feb 24,1135	535	553	528	

WALLACE AND TIERNANS

TIME	No 93	No 94	No 95	COMMENTS
Feb 18,1445	1200	1200	1200	Comments about Paulins for corresponding times apply to Wallace and Tiernans.
Feb 19,0900	1134	1134	1134	
Feb 19 0953	1159	1159	1158	
Feb 19,1200	1298	1296	1297	
Feb 19,1430	1380	1380	1373	
Feb 24,1018	500	500	500	Reset
Feb 24,1020				
Feb 24,1023	499	499	500	
Feb 24,1025	498	499	499	
Feb 24,1030	499	500	500	
Feb 24,1035	501	501	503	

TIME TEST Con't.

TIME	No 93	No 94	No 95	COMMENTS
Feb 24,1040	503	505	505	Comments about Paulins for corresponding times apply to Wallace and Tiernans.
Feb 24,1045	507	508	507	
Feb 24,1050	508	509	508	
Feb 24,1055	509	509	509	
Feb 24,1100	505	509	505	
Feb 24,1105	501	504	501	
Feb 26,1110	506	511	506	
Feb 24,1115	510	512	510	
Feb 24,1120	513	512	512	
Feb 24,1125	516	517	516	
Feb 24,1130	517	518	516	
Feb 24,1135	517	519	518	

ONE BASE ELEVATION CHECK - PAULINS

FEB 19	TROY BLDG.				R.R. STATION				MEAN	TEMP	INSTRU	COMPUTED DIFF.		
TIME	TEMP	No 75	No 56	No 91	Temp	No 56	No 91	No 75	TEMP	CORR	CORR.	No 56	No 91	No 75
1300	42	928			49	730	732		46	-1.9		197	194	
1305	43	940			47	740	739		45	-1.9		198	199	
1310	43	940			46	744	743		44	-2.0		194	195	
1315	43	945			45	745	743		44	-2.2		198	200	
1320	43	943			46	744	760		44	-1.9		197	191	
1325	42	960			45	762	768		44	-2.2		196	190	
1345	41		983	994	44			781	42	-2.8				199
1350	40		990	1001	44			789	42	-2.9				198
1355	40		989	1001	44			789	42	-2.9				197
1400	41		992	1005	45			790	43	-2.6				199
1405	42		992	1008	45			790	43	-2.4				200
1410	41		1005	1017	44			794	43	-2.4				209

ACTUAL DIFFERENCE IN ELEVATION = 189.2 feet.

ONE BASE ELEVATION CHECK-WALLACE AND TIERNANS.

DIFFERENCE IN ELEVATION = 189.2 feet.

FEB 19	TROY BLDG				R.R. STATION				MEAN	TEMP	INSTRU	COMPUTED DIFF.		
TIME	TEMP	No 94	No 93	No 95	TEMP	No93	No 95	No 94	TEMP	CORR	CORR (for 95)	No 93	No 95	No 94
1300	42	1319			49	1127	1124		46	-1.9	-0.5	190	195	
1305	43	1324			47	1132	1139		45	-1.9	-1.0	190	194	
1310	43	1325			46	1131	1129		44	-2.0	-1.5	192	193	
1315	43	1326			45	1134	1131		44	-2.2	-2.0	190	193	
1320	43	1331			46	1141	1137		45	-1.9	-2.5	189	190	
1325	42	1339			45	1148	1143		44	-2.2	-3.0	189	191	
1345	41		1360	1356	44			1171	42	-2.8				186
1350	40		1363	1360	44			1174	42	-2.9				186
1355	40		1364	1361	44			1174	42	-2.9				187
1400	41		1363	1360	45			1174	43	-2.6				186
1405	42		1359	1360	45			1176	43	-2.4				186
1410	41		1371	1367	44			1181	43	-2.4				188

ACCURACY OF ALIGNING PAULINS

INSTR. NUMBER	READING NUMBER	READING	CHANGE
56	1	754	
"	2	754	0
"	3	759	+5
"	4	760	+1
"	5	761	+1
"	6	760	-1
"	7	764	+4
75	1	758	
"	2	759	+1
"	3	765	+6
"	4	765	0
"	5	765	0
"	6	766	+1
"	7	770	+4

DIFFERENCE BETWEEN CORRESPONDING CHANGES OF THE TWO INSTRS.	
BETWEEN READINGS NUMBER	DIFF.
1-2	1
2-3	1
3-4	1
4-5	1
5-6	2
6-7	0
1-3	2
1-4	1
1-5	0
1-6	2
1-7	2
2-3	1
2-4	0
2-5	1
2-6	1
2-7	1
3-5	2
3-6	0
3-7	0
4-6	1
4-7	1
5-7	2

TEST PROFILE

After the instruments had been tested as previously described, work was started to prepare for a test run on points of known elevation in order to approximate actual field conditions using the two makes of instruments and employing both the single base and two base methods. Starting from the Troy Building bench mark, a wye level run was made to a point about half way down the hill, and seven points of known elevation were established to be used as field stations. As can be seen from the data sheets the elevations of these points (called BM 1 to BM 7) varied from that of the Troy Building bench mark by from +3.0 to -94.7 feet.

With the elevations of these points determined, readings of elevation and temperature at the Troy Building bench mark and bench mark T-42 ,used as the bases, were taken every five minutes, while readings were made on the roving instrument at the various field stations(BM 1 to BM 7).

The results of this test may be seen from the succeeding data and computation sheets. The graphs were drawn up to readily show 1) the variations of the computed from the actual elevations, 2) the relative accuracy of the two makes of altimeters, and 3) the relative accuracy of the two methods of barometric leveling.

On these graphs the errors of computed from actual elevations were plotted, first against distance from the upper base, and secondly against elevation difference

from the upper base. It is interesting to note that all four sets of curves so obtained are of basically the same shape, independent of method of computation or abcissa. The following are the conclusions derived from the results of this run:

1) The Wallace and Tiernan instruments have a more constant error and in the majority of cases a smaller error than the Paulin make.

2) The accuracy of the Paulin instruments approach that of the Wallace and Tiernan when the distance and/or elevation difference from the bases is relatively large; that is, in the middle of the area between the two bases.

3) The error of the Paulin instrument is greatest close to the base. This apparently contradicts any reasonable assumptions and it was hoped that an explanation could be obtained in later tests.

4) Results were within the limits of accuracy for plotting five foot contours.

5) Although both single and two base methods give satisfactory results, those with the two base method were more accurate, recommending this method over the single base method.

OPERATION SINGLE BASE METHOD- This method requires the use of two altimeters, two thermometers and two watches. A base of known elevation is required. At the start the two instruments are compared at the base over a ten minute period, and a mean obtained for each. Then one instrument is left at the base, and readings of the instrument and one of the thermometers taken at five minute intervals. The other altimeter and thermometer (called "field instrument") are taken into field to points whose elevation is desired. Readings are taken and time of reading recorded. At the end of the work the " field instrument" is brought back to the base and the two are again compared. The change in the " field instrument" from start to end is assumed a straight line variation. In computing the elevation of a field point the mean of the readings on that point and the station altimeter at the same time are taken. This allows for weather changes in barometeric pressure. A correction is applied for temperature to give the correct elevation of the field point.

OPERATION TWO BASE METHOD - For this method three altimeters and three watches are required. Two bases of known elevation are required. At the start all three altimeters are compared on one of the bases. Then one altimeter is taken to the other base and one taken into the field. Base instruments are read every five minutes. The " field instrument" is read on the points in the field whose elevation is desired. At the end of work all three are again compared at the base at which

they were compared at the start. The sum of the difference between the " field instrument" and the two base altimeters will not add up to give the same difference there is between the two base altimeters. This is because no temperature correction is made. The temperature between the two bases is assumed to vary in a straight line proportional to difference in elevation. To compute the elevation of the field station find the difference between the field station and one of the bases. Find the difference in readings between the bases. Divide the former by the latter and multiply by the actual difference in elevation of bases. This gives the corrected difference between the field station and the base chosen.

3 March, 1948

LEVEL NOTES FOR TEST PROFILE

STA	PLUS SIGHT	H.I.	MINUS SIGHT	ELEV.	COMMENTS
T.B. BM	10.65	236.01		225.36	BM1-Top step second flight west of Sage entrance.
BM1	1.92	230.36	7.57	228.44	
TP1	2.12	220.18	12.30	218.06	BM2- Base of steps east entrance Chem Building.
BM2	4.11	213.04	11.25	208.93	
TP2	2.68	204.04	11.68	201.36	BM3- NW corner of rectangular sewer grid opposite W entrance to Proudfit Building.
BM3	0.83	198.18	6.69	197.35	
TP3	0.35	185.59	12.94	185.24	
TP4	2.49	177.44	10.64	174.95	BM4-Top wall SE of Pitt. Bldg.
BM4	1.42	168.09	10.77	166.67	
TP5	2.68	159.91	11.86	157.23	BM5-Top 3rd series steps from bottom of walk along road from 8th ave to Pitt. Bldg.
BM5	2.46	148.59	12.78	146.13	
BM6	0.75	137.44	11.90	136.69	
BM7			6.76	130.68	BM6- 7th step from bottom of above walk.
					BM7-Top of step rail at head of Broadway at 8th st.

DATA FOR TEST PROFILE

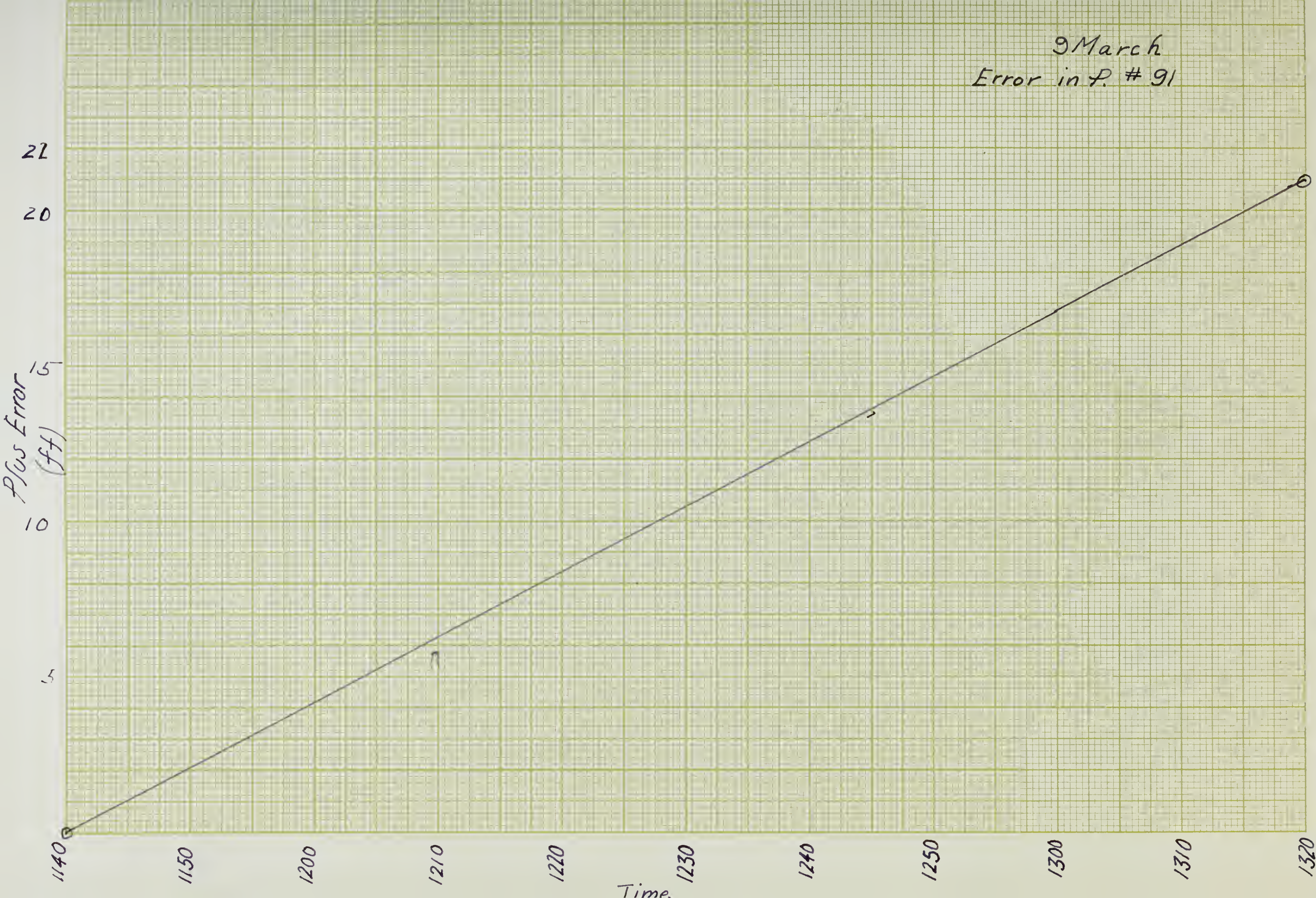
9 March, 1948

Weather- Damp, cold,cloudy.

COMPARISON OF ALTIMETERS at Troy Building bench mark.

[illegible]	PAULINS			W and T			TEMPERATURE
	No 56	No 75	No 91	No 93	No 94	No 95	
START	400	400	400	1200	1200	1200	38
END	433	433	454	1230	1230	1231	38

TROY BLDG BENCH				R.R. STA. BENCH			FIELD ALTIMETERS				
TIME	TEMP	No 75	No 95	No 91	No 93	TEMP	TIME	TEMP	No 56	No 94	STA
1210	38	416	1207	227	1013	42	1210	40	392	1191	BM2
1215	36	417	1208	232	1016	40	1214	37	380	1183	BM3
1220	36	417	1209	233	1017	40	1224	37	365	1155	BM4
1225	36	423	1212	239	1021	40	1229	40	343	1133	BM5
1230	36	423	1212	242	1021	40	1232	41	334	1126	BM6
1235	36	427	1218	247	1027	40	1235	43	331	1121	BM7
1240	37	432	1220	253	1031	40	1237	44	333	1123	BM7
1245	37	432	1223	257	1036	40	1243	48	342	1134	BM6
1250	37	433	1226	256	1034	40	1247	50	355	1145	BM5
1255	37	433	1223	256	1033	40	1253	45	375	1165	BM4
1300	37	433	1224	256	1033	40	1258	36	404	1192	BM3
1305	38	436	1225	257	1034	40	1302	42	416	1206	BM2
1310	38	436	1228	260	1038	40	1306	46	433	1231	BM1


9 March
Error in P. #91

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

U.B. Sta.- Troy building ,Elev.225.4
L.B. Sta.- T-42 ,Elev. 36.2
K= Diff. of Elev. =189.2

WALLACE AND TIERNAN ALTIMETERS

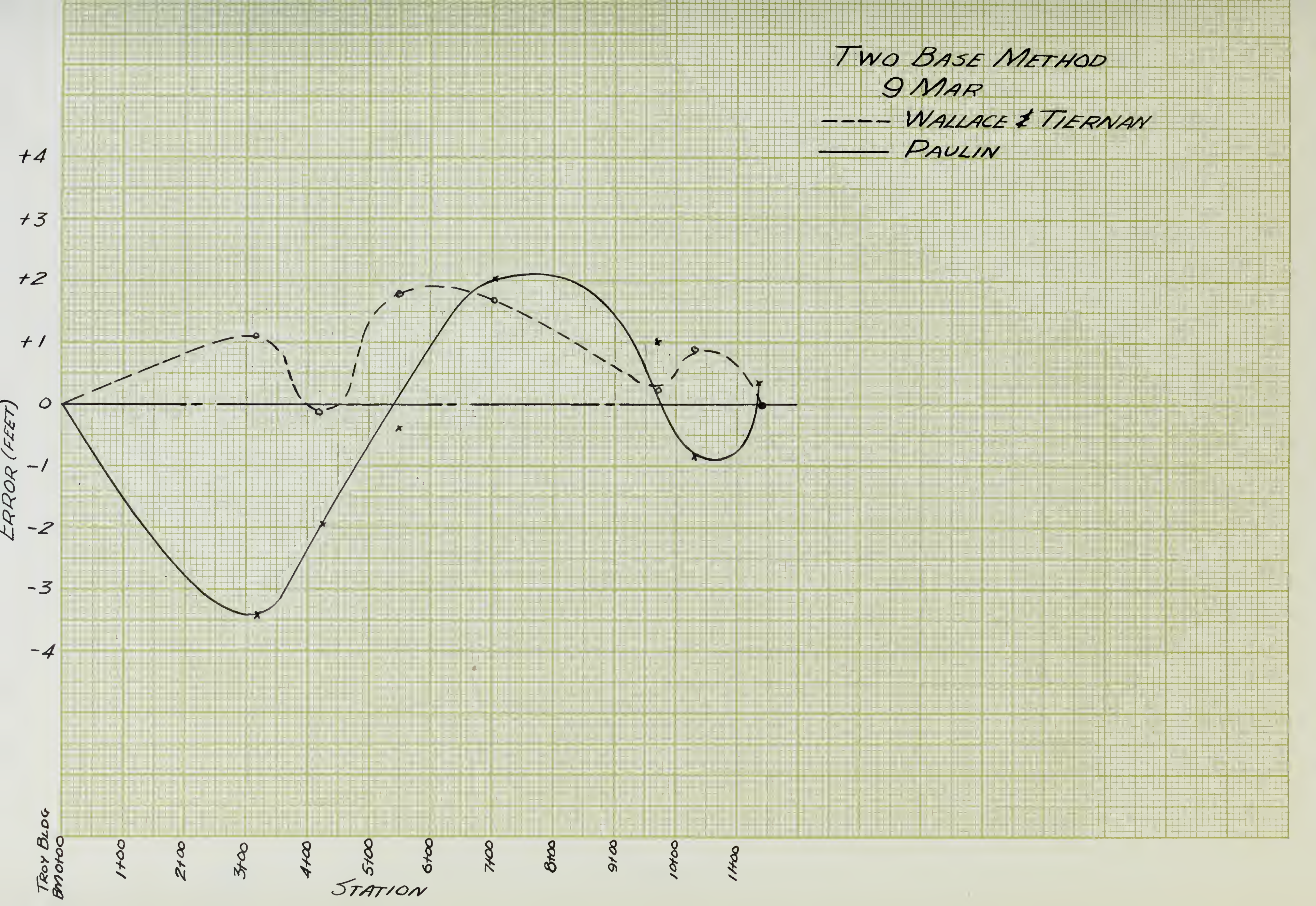
FIELD STA.	KEY TO COMP.	BM2	BM2	BM3	BM3	BM4	BM4	BM5	BM6	BM6	BM7	BM7
TIME		1210	1302	1214	1258	1224	1253	1229	1232	1243	1235	1237
READING,FS	1	1191	1206	1183	1196	1155	1165	1133	1126	1134	1121	1123
READING,LB	2	1013	1033	1015	1033	1020	1033	1021	1023	1034	1021	1029
F.S.-L.B.	3=1-2	178	173	168	163	135	132	112	103	100	100	94
READING,UB	4	1207	1224	1208	1224	1211	1224	1212	1214	1222	1218	1219
READING,LB	5	1013	1033	1015	1033	1020	1033	1021	1023	1034	1021	1029
U.B.-L.B.	6=4-5	194	191	193	191	191	191	191	191	188	197	190
QUOT.X K	7=3/6XK	173.4	171.5	164.7	161.4	133.6	130.9	110.0	102.1	100.7	96.1	93.6
ELEV.L.B.	8	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2
ELEV.F.S.	9=7+8	209.6	207.7	200.9	197.6	169.8	167.1	146.2	138.3	136.9	132.3	129.8
AVERAGE			208.7		199.2		168.4	146.2		137.6		131.0
ACTUAL ELEV.			208.9		197.4		166.7	146.1		136.7		130.7
ERROR			-0.2		+1.8		+1.7	+0.1		+0.9		+0.3

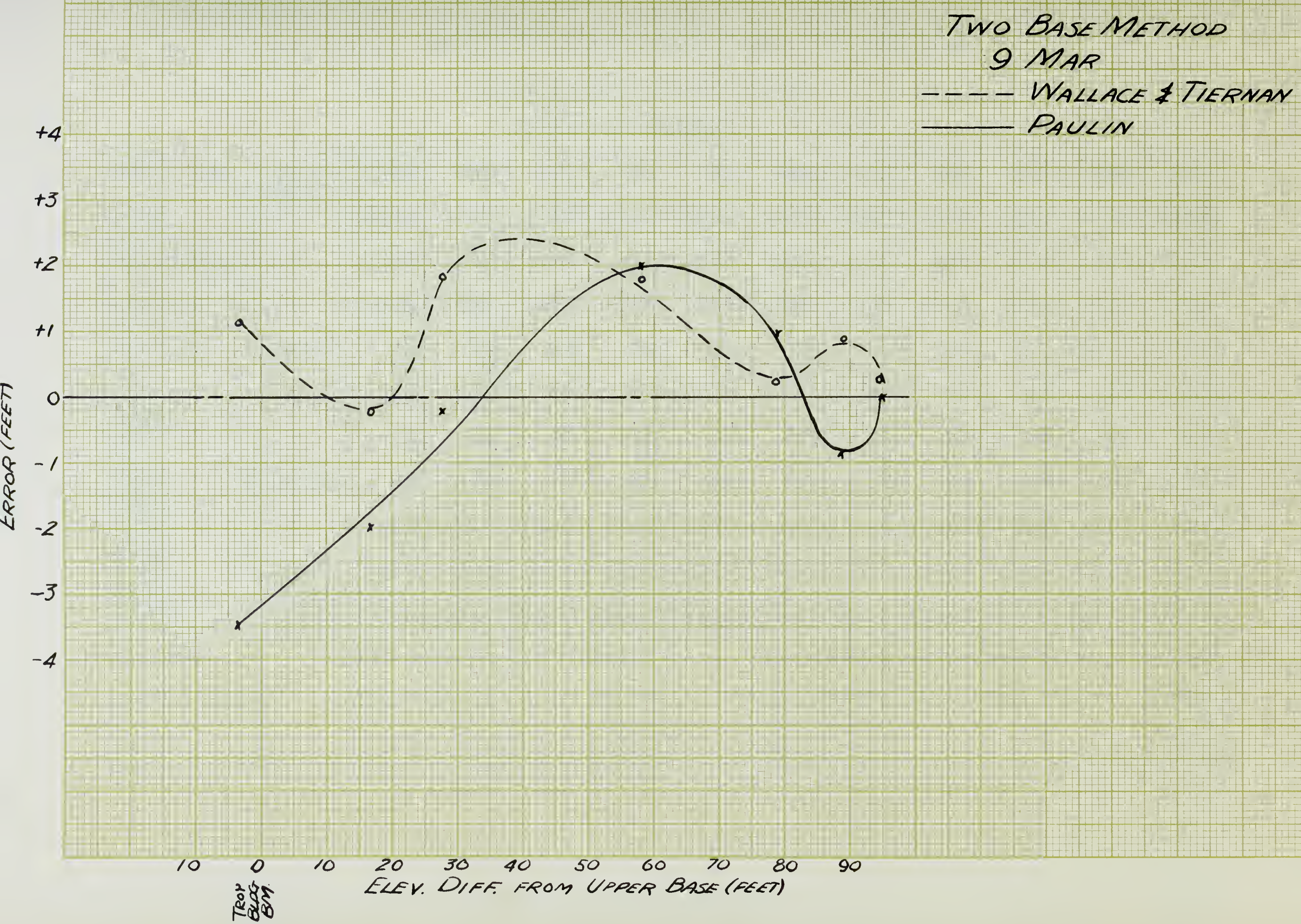
ALTIMETER COMPUTATION SHEET, FOR TWO BASES

U.B. Sta.- Troy building, Elev 225.4
L.B. Sta.- T-42 , Elev 36.2
K= Diff. of Elev = 189.2

PAULIN ALTIMETERS

FIELD STA.	KEY TO COMP.	BM2	BM2	BM3	BM4	BM4	BM5	BM5	BM1	BM6	BM6	BM7
TIME		1302	1210	1258	1224	1253	1229	1247	1306	1243	1232	1235
READING,FS	1	416	392	404	365	375	343	355	435	342	334	331
READING,LB	2	239	221	239	230	240	232	242	239	242	233	235
F.S.-L.B.	3= 1-2	177	171	165	135	135	111	113	196	100	101	96
READING,UB	4	434	416	433	423	433	423	432	436	432	425	427
READING,LB	5	239	221	239	230	240	232	242	239	242	233	235
U.B.-L.B.	6= 4-5	195	195	194	193	193	191	190	197	190	192	192
QUOTIENTXK	7=3/6XK	171	166.0	161	132.0	132.5	110.0	112.5	188.7	99.6	99.6	94.5
ELEV.L.B.	8	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2	36.2
ELEV.F.S.	9= 7+8	207.2	202.2	197.2	168.2	168.7	146.2	148.7	224.9	135.8	135.8	130.7
AVERAGE		206.9		197.2		168.4		147.4	224.9		135.8	1307
ACTUAL ELEV		208.9		197.4		166.4		146.4	228.4		136.7	130.7
ERROR		-2.0		-0.2		+ 2.0		+ 1.0	+ 3.5		+ 0.9	+ 0.0


Two Base Method
9 Mar
---- Wallace & Tiernan
—— Paulin
+4
+3
+2
+1
0
-1
-2
-3
-4
Error (Feet)
Troy Bldg BM0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
11+00
Station


TWO BASE METHOD
9 MAR
WALLACE & TIERNAN
PAULIN
+4
+3
+2
+1
0
-1
-2
-3
-4
ERROR (FEET)
10
0
10
20
30
40
50
60
70
80
90
TROY BLDG BM.
ELEV. DIFF. FROM UPPER BASE (FEET)

ALTIMETER COMPUTATION SHEET, FOR ONE BASE

K= Base elevation = 225.4

PAULIN ALTIMETERS

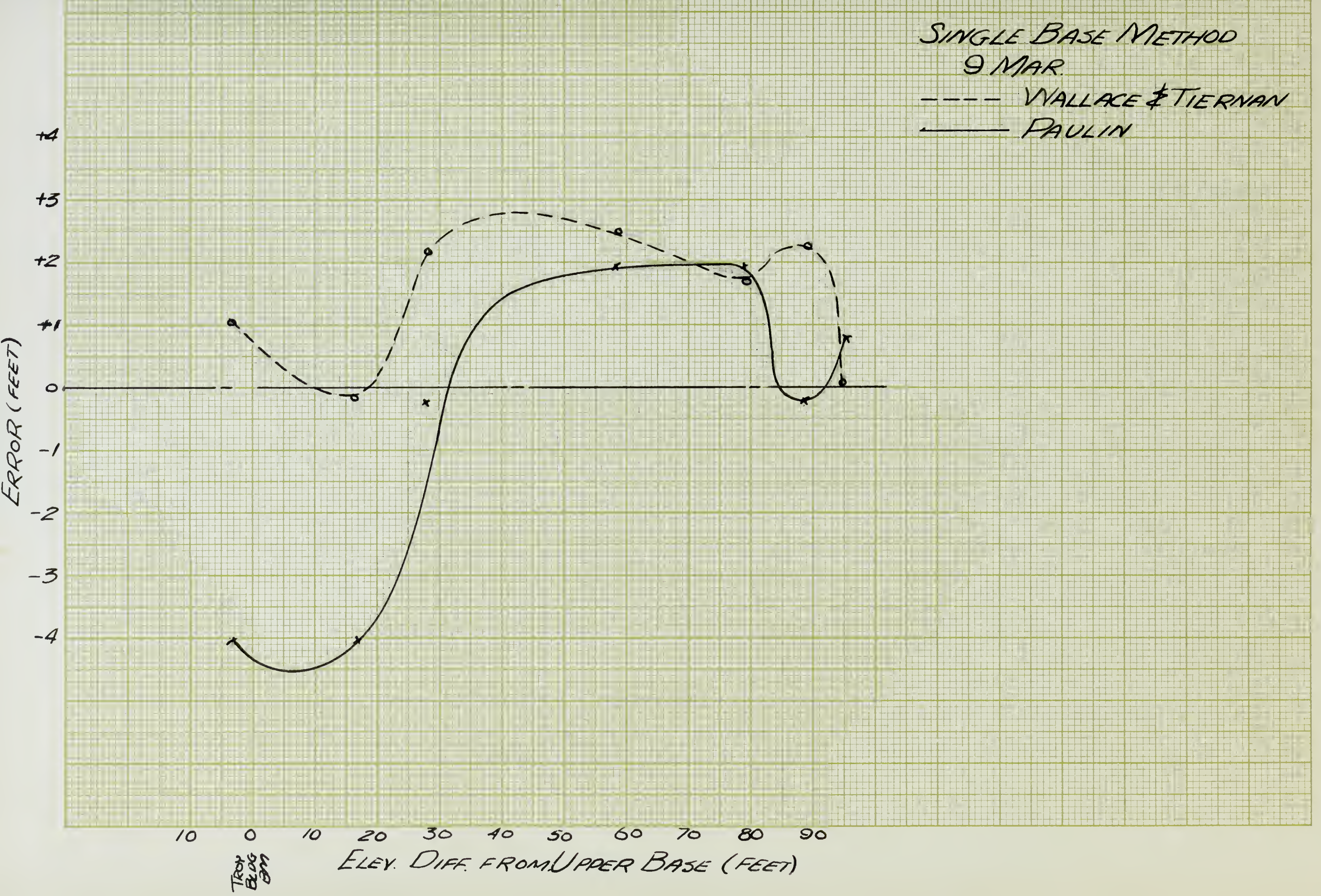
FIELD STA	KEY TO COMP.	BM2	BM3	BM4	BM4	BM5	BM5	BM1	BM6	BM6	BM7	BM7
TIME		1302	1210	1258	1224	1253	1229	1247	1243	1232	1235	1237
READING, B.	1	434	433	423	433	423	432	436	432	425	427	429
READING, F.S.	2	416	404	365	375	343	355	435	342	334	331	333
B.-F.S.	3=2-1	18	29	58	58	80	77	1	90	91	96	96
TEMP. BASE	4	37	37	36	37	36	37	38	37	36	36	36
TEMP F.S.	5	42	36	37	45	40	50	42	48	41	43	44
TEMP MEAN	6=4+5/2	40	36	36	41	38	44	40	43	39	40	40
TEMP. CORR.	7	-0.4	-0.8	-1.6	-1.0	-1.9	-0.9	0	-1.2	-2.0	-1.9	-1.9
ELEV. DIFF.	8=7+3	17.6	28.2	56.4	57.0	78.1	76.1	1.0	88.8	89.0	93.9	93.9
ELEV.	9=K-8	207.8	197.2	169.0	168.4	147.3	149.3	224.4	136.6	136.4	131.5	131.5
AVERAGE		207.8	197.2		168.7		148.3	224.4		136.5		131.5
ACTUAL ELEV		208.9	197.4		166.5		146.4	228.4		136.8		130.7
ERROR		-4.0	-0.2		+2.2		+1.9	- 4.0		+ 0.2		+ 0.8

ALTIMETER COMPUTATION SHEET, FOR ONE BASE

K=Base elevation = 225.4

WALLACE AND TIERNAN ALTIMETERS

FIELD STA	KEY TO COMP.	BM4	BM4	BM5	BM6	BM6	BM7	BM7	BM1	BM2	BM2	BM3
TIME		1224	1253	1247	1232	1243	1246	1237	1306	1210	1302	1258
READING, B.	1	1211	1224	1224	1214	1222	1218	1219	1227	1207	1224	1224
READING, FS	2	1155	1165	1145	1126	1143	1121	1123	1231	1191	1206	1196
B.-F.S.	3=2-1	56	59	79	88	88	97	96	-4	16	18	28
TEMP. BASE	4	36	37	37	36	37	36	36	38	37	37	37
TEMP. F.S.	5	37	45	60	41	48	43	44	42	40	42	36
TEMP MEAN	6=4+5/2	36	41	43	38	43	40	40	40	39	40	37
TEMP CORR.	7	-1.5	-1.1	-1.1	-2.1	-1.2	-1.9	-1.9	-0.1	-0.4	-0.4	-0.7
ELEV DIFF.	8=7+3	54.6	57.9	77.9	85.9	86.8	95.1	94.1	-4.1	15.6	17.6	27.3
ELEV.	9=K-8	170.9	167.5	147.5	139.5	138.6	130.3	131.3	229.5	209.8	207.8	198.1
AVERAGE			169.2	147.5	139.0			130.8	229.5		208.8	198.1
ACTUAL ELEV			166.7	146.1	136.7			130.7	228.4		208.9	197.3
ERROR			+ 2.5	+1.4	+ 2.3			+ 0.1	+1.1		- 0.1	+ 0.8


SINGLE BASE METHOD
9 MAR.
WALLACE & TIERNAN
PAULIN
+4
+3
+2
+1
0
-1
-2
-3
-4
ERROR (FEET)
10
0
10
20
30
40
50
60
70
80
90
TROY BLDG BM
ELEV. DIFF. FROM UPPER BASE (FEET)

CONDUCT OF SURVEY

CONTOUR PLOTTING ON PHOTOGRAPHS

For the actual test of the instruments in plotting contours on aerial photographs, a portion of the town of Rensselaer, N. Y. was chosen for several reasons: (1) this section had been used by Lts. Graves and Nicholson for contour plotting by the single base method using Wallace and Tiernan altimeters and thus a ready comparison of the methods could be made ,(2) the territory covered contained fields , woods, hills and farm and residential districts, thus covering most of the conditions that would be encountered in any survey, and (3) aerial photographs of this section were readily available from a flight flown by the Fairchild Aerial Survey Corp.

It was obvious from the preliminary tests of the instruments that best results would be obtained if the area surveyed was intermediate in elevation between the two bases, so the first work to be accomplished was to determine the altitude of a suitable upper base. This was done by leveling approximately 0.8 mile from the base used by Graves and Nicholson and establishing a base on a hill about 110 feet higher than the Graves-Nicholson base. Using this as an upper base and the Rensselaer City benchmark at the corner of Aiken and Broadway Streets as a lower base, the actual field readings were started.

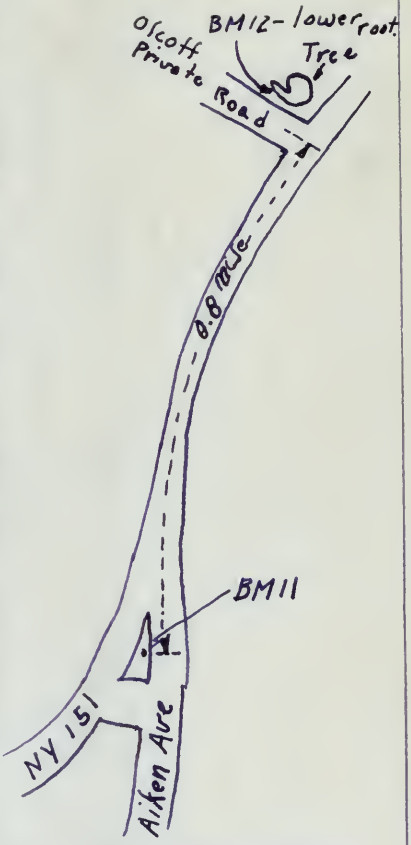
All six instruments were set at the lower base at the start of each day's work and returned and compared there at the end of the day for determination of any correction

necessary because of non-uniformity of change of scale readings. After setting the instruments, one of each type was left at the lower base and one of each type taken to the upper base; these base instruments being read every five minutes. The remaining instruments were taken into the field and used as the roving instruments. Points readily identifiable on the photograph and in the field were chosen by the man with the roving instruments, marked on the photograph, and readings taken. 9" X 9" photographs, scale 600 feet per inch, were used in the field for point identification. The elevations of these points were computed as shown on the data sheets and these elevations marked on the photographs. One 27" X 27" photograph, scale 200 feet per inch, was used for the results of the Paulin instruments and one for the Wallace and Tiernans, and five foot contours were drawn directly on them. To check the accuracy of the plots two check lines were used, the elevations along these lines being accurately determined by wye level runs. The check line used by Graves and Nicholson was used as check line number one.

It was observed that 95% of the Wallace and Tiernan contours were within one-half the contour interval (as determined by the check lines) while only 50% of the Paulins were within one-half the contour interval. Field experience with the two types had led the writers to expect that the results would be somewhat as determined, since throughout the work the Paulins had been erratic and expecially Paulin number 91 had appeared to be inaccurate.

LEVEL NOTES 24 March,1948

Extension of control bases, Town of Rensselaer,N.Y.

STA	PLUS SIGHT	H.I.	MINUS SIGHT	ELEV.	COMMENTS
BM11	11.54			187.54	BM11 --Base of fire-hydrant at intersection of Aiken St and highway,N Y 161.
TP 1	10.59	199.08	1.90	197.18	
TP 2	10.28	207.77	3.12	204.65	
TP 3	12.96	214.93	1.48	213.48	 Oscoff Private Road BM12- lower root Tree 0.8 mile BM11 NY 151 Aiken Ave
TP 4	11.51	226.41	1.37	225.04	
TP 5	11.47	236.55	0.39	236.16	
TP 6	10.28	247.63	1.79	245.84	
TP 7	10.96	256.08	2.61	253.47	
TP 8	10.93	264.43	2.03	262.40	
TP 9	10.67	273.33	2.28	271.05	
TP10	11.34	281.72	2.13	279.59	
TP11	10.16	290.93	2.70	288.23	
BM12		298.39	1.07	297.32	
	Σ 132.65		Σ 22.87		
	- 22.87				
	109.78				
	+ 187.54				
	297.32				

30 March 1948

RENSSELAER,N.Y.

Weather-Clear,warm

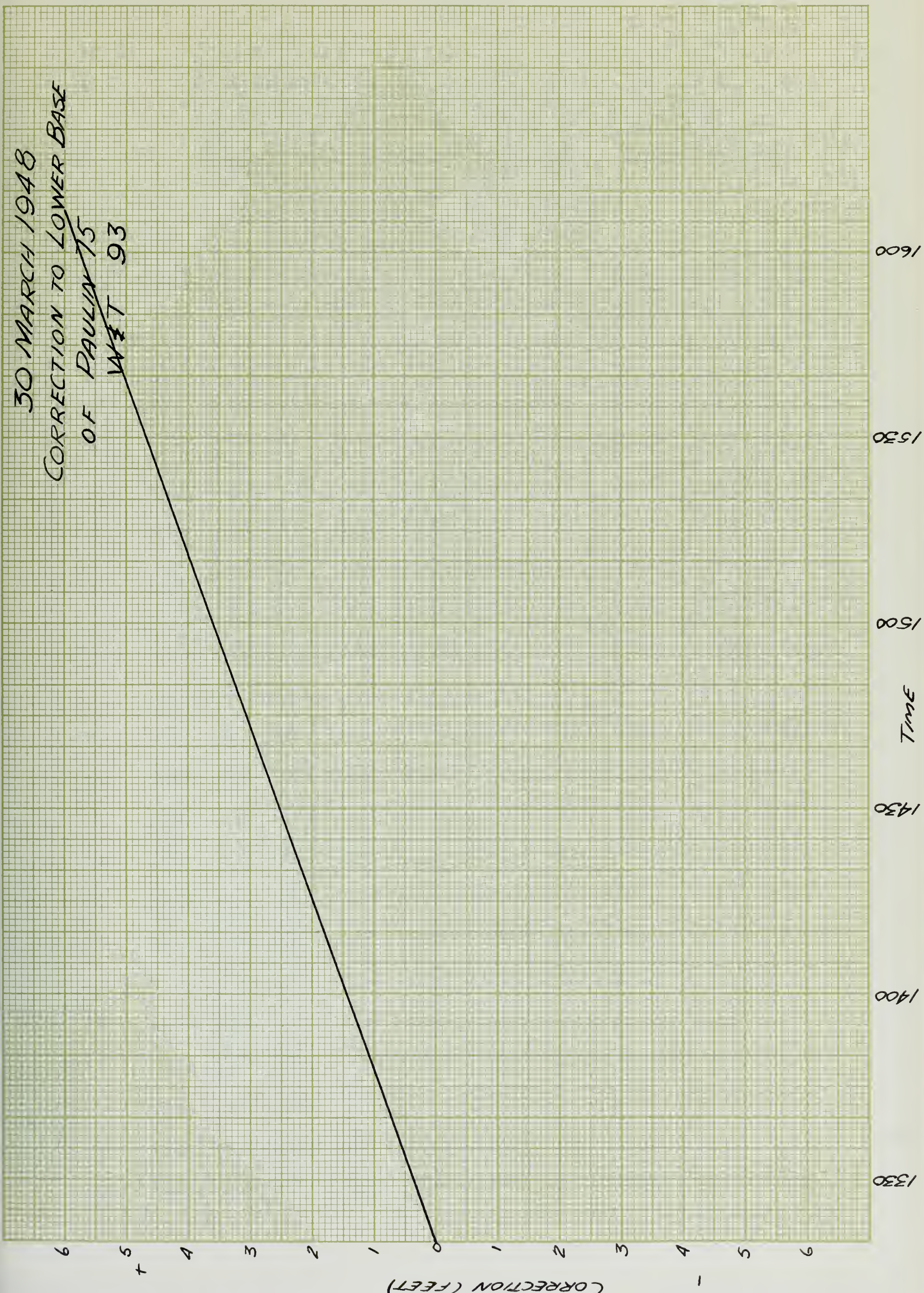
	TIME	PAULIN			W and T		
		56	75	91	93	94	95
START	1320	200	200	200	1000	1000	1000
END	1607	212	206	212	994	1000	999

	LOWER B.		UPPER B.	
TIME	56	94	91	95
1335	207	1004	492	1280
1340	208	1003	492	1280
1345	210	1004	492	1278
1350	210	1003	492	1279
1355	217	1006	491	1279
1400	215	1003	490	1276
1405	210	1000	490	1277
1410	209	1000	489	1275
1415	210	1000	492	1275
1420	211	1001	495	1280
1425	211	1001	499	1280
1430	213	1002	502	1285
1435	208	1000	502	1280
1440	214	1000	505	1285
1445	216	1001	505	1285
1450	216	1000	505	1280
1455	215	1000	505	1280
1500	215	1003	507	1285
1505	216	1000	510	1286
1510	214	1000	510	1285

FIELD INSTR.			
TIME	STA.	75	93
1337	1	398	1187
1342	2	370	1162
1345	3	378	1170
1351	4	364	1158
1353	5	354	1147
1357	6	339	1130
1402	7	354	1148
1405	8	362	1152
1410	9	381	1172
1415	10	366	1151
1417	11	355	1149
1422	12	380	1174
1428	13	341	1135
1433	14	365	1160
1442	15	357	1152
1446	16	376	1171
1450	17	371	1166
1455	18	375	1170
1500	19	385	1175
1506	20	383	1174

30 March 1948 Cont'd.

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	56	94	91	95	TIME	STA.	75	93
1515	214	1000	510	1283	1511	21	376	1161
1520	214	1000	506	1280	1515	22	360	1146
1525	214	1000	506	1285	1520	23	379	1162
1530	211	999	506	1280	1528	24	362	1146
1535	212	1000	501	1270	1532	25	368	1150
1540	211	1000	497	1273	1537	26	367	1151
1545	210	1000	497	1273	1543	27	330	1119
1550	212	1000	495	1275	1548	28	370	1161
1555	212	1000	495	1270	1551	29	387	1171

30 MARCH 1948
CORRECTION TO LOWER BASE
OF PAULIN 75
W&T 93
TIME
1330
1400
1430
1500
1530
1600
CORRECTION (FEET)
+
-
6
5
4
3
2
1
0
1
2
3
4
5
6

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE: 3/30/48

U.B. Sta.-BM 12- Elev 297.32
L.B. Sta.-BM 10- Elev 19.75
K=Diff. of Elev = 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
1	1337	1188	1004	184	1279	1004	275	186.9	19.7	206.6
2	1342	1163	1003	160	1279	1003	276	160.1	19.7	179.8
3	1345	1171	1004	167	1278	1004	274	168.9	19.7	188.6
4	1351	1159	1004	155	1278	1004	274	156.6	19.7	176.3
5	1353	1148	1005	143	1279	1005	274	144.0	19.7	163.7
6	1357	1131	1005	126	1278	1005	273	128.0	19.7	147.7
7	1402	1147	1002	145	1276	1002	274	147.0	19.7	166.7
8	1405	1154	1000	154	1277	1000	277	154.2	19.7	173.9
9	1410	1174	1000	174	1275	1000	275	175.0	19.7	194.7
10	1415	1153	1000	153	1275	1000	275	154.6	19.7	174.3
11	1417	1151	1001	151	1277	1001	276	150.0	19.7	169.7
12	1422	1172	1001	171	1280	1001	279	169.2	19.7	188.9
13	1428	1137	1001	136	1283	1001	282	130.0	19.7	149.7
14	1433	1163	1001	162	1282	1001	281	152.0	19.7	171.7
15	1442	1155	1000	155	1285	1000	286	143.8	19.7	163.5
16	1446	1174	1001	173	1285	1001	284	160.5	19.7	180.2
17	1450	1169	1000	169	1280	1000	280	159.9	19.7	179.6
18	1455	1173	1000	173	1280	1000	280	163.9	19.7	183.6
19	1500	1178	1003	175	1284	1003	281	167.5	19.7	187.2
20	1506	1177	1000	177	1288	1000	286	169.1	19.7	188.8
21	1511	1165	1000	165	1285	1000	285	158.1	19.7	177.8

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS   DATE: 3/30/48

U.B. STA. - BM 12- Elev 297.32
L.B. STA. - BM 10- Elev 19.75
K=Diff. of Elev = 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
22	1515	1150	1000	150	1283	1000	283	144.5	19.7	164.2
23	1520	1166	1000	166	1280	1000	280	161.9	19.7	181.6
24	1528	1150	999	151	1283	999	284	143.2	19.7	162.9
25	1532	1154	999	155	1273	999	274	157.5	19.7	171.2
26	1537	1155	1000	155	1272	1000	272	158.0	19.7	177.7
27	1543	1124	1000	124	1273	1000	273	125.5	19.7	145.2
28	1548	1161	1000	166	1278	1000	278	165.5	19.7	185.2
29	1551	1176	1000	176	1270	1000	270	181.0	19.7	200.7

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

PAULIN ALTIMETERS DATE:3/30/48

U.B. Sta-BM 12- Elev 297.32
L.B. Sta-BM 10- Elev 19.75
K=Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	Quot X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
1	1337	399	207	192	491	207	284	187.5	19.7	207.2
2	1342	371	209	162	491	209	282	159.2	19.7	178.9
3	1345	379	210	169	491	210	281	166.6	19.7	186.3
4	1351	365	211	154	491	211	280	152.5	19.7	172.2
5	1353	355	215	140	490	215	275	141.5	19.7	161.2
6	1357	340	216	124	490	216	274	125.5	19.7	145.2
7	1402	356	213	143	489	213	276	144.8	19.7	164.5
8	1405	364	210	154	489	210	279	153.0	19.7	172.7
9	1410	383	209	174	489	209	279	172.9	19.7	192.6
10	1415	368	210	158	491	210	281	156.0	19.7	175.7
11	1417	357	210	147	492	210	282	144.5	19.7	164.2
12	1422	382	211	171	495	211	284	166.8	19.7	186.5
13	1428	343	212	131	499	212	287	126.5	19.7	146.2
14	1433	368	210	158	500	210	290	151.0	19.7	170.7
15	1442	360	215	145	503	215	288	139.6	19.7	159.3
16	1446	379	216	163	503	216	287	157.5	19.7	177.2
17	1450	374	216	158	503	216	287	152.6	19.7	172.3
18	1455	378	215	163	503	215	288	157.0	19.7	176.7
19	1500	389	215	174	503	215	288	167.6	19.7	187.3
20	1506	387	216	171	507	216	291	163.1	19.7	182.8
21	1511	380	214	166	507	214	293	156.9	19.7	176.6
22	1515	364	214	150	507	214	293	141.7	19.7	161.4

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

PAULIN ALTIMETERS DATE: 3/30/48

U.B. Sta- BM 12 - Elev 297.32
L.B. Sta- BM 10 - Elev 19.75
K=Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
23	1520	383	214	169	503	214	289	162.1	19.7	181.8
24	1528	367	212	155	503	212	291	147.6	19.7	167.3
25	1532	373	211	162	501	211	290	155.0	19.7	174.7
26	1537	372	212	160	496	212	284	156.0	19.7	175.7
27	1543	335	210	125	494	210	284	121.8	19.7	141.5
28	1548	375	211	164	492	211	281	161.5	19.7	181.2
29	1551	392	212	180	491	212	279	179.0	19.7	198.7

5 April 1948

RENSSELAER,N.Y.

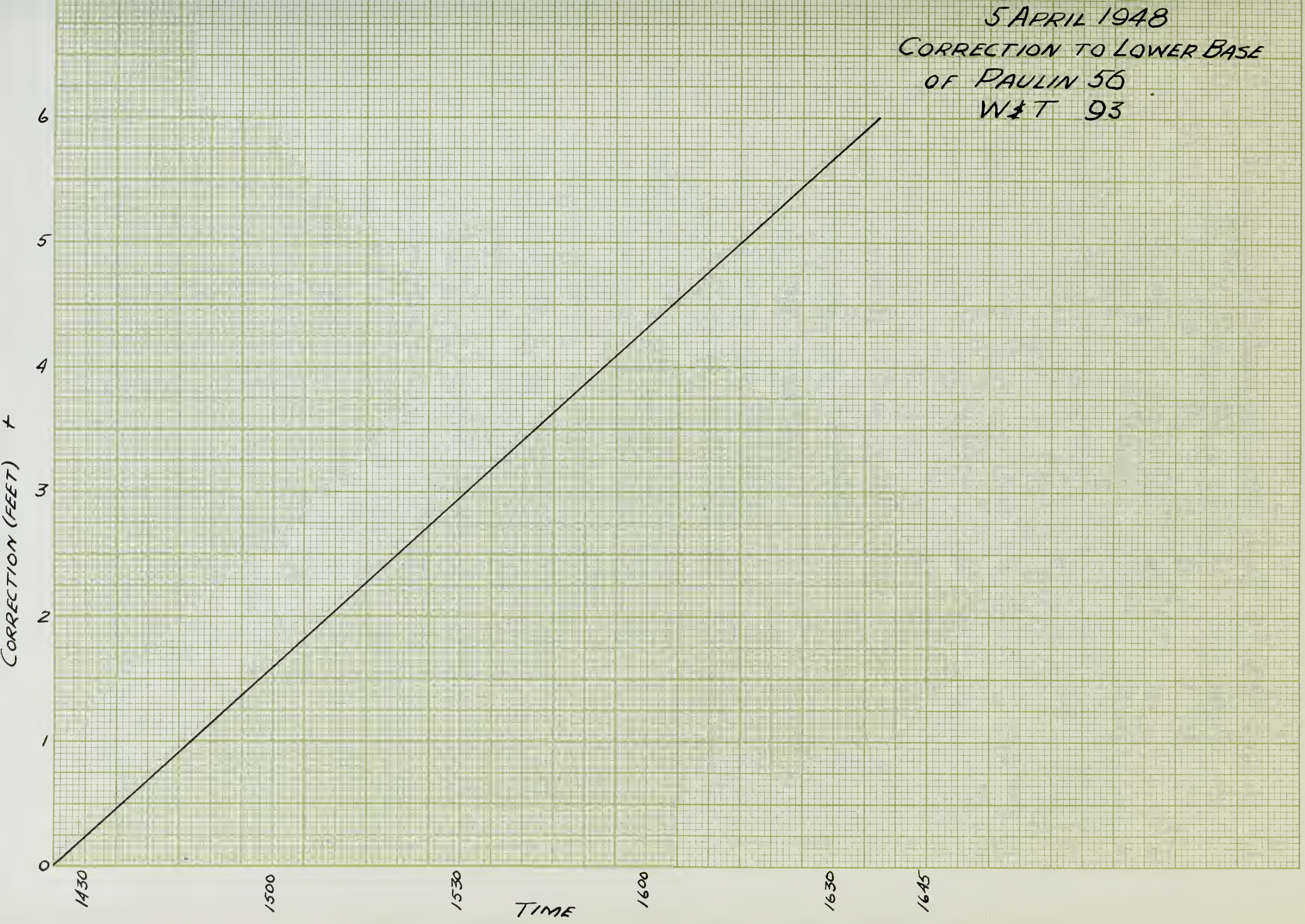
Weather-Clear,warm,slight breeze.

	TIME	PAULIN			W and T		
		56	75	91	93	94	95
START	1425	200	200	200	993	993	993
END	1637	246	253	251	1033	1039	1038

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	75	94	91	95	TIME	STA.	56	93
1440	206	1003	482	1268	1440	30	360	1147
1445	207	1004	484	1267	1445	31	351	1140
1450	207	1005	483	1269	1449	32	314	1108
1455	213	1008	486	1271	1453	33	355	1142
1500	217	1009	488	1276	1459	34	355	1142
1505	225	1015	491	1278	1501	35	317	1117
1510	227	1017	491	1280	1505	36	307	1099
1515	229	1018	495	1281	1511	37	361	1153
1520	233	1019	495	1282	1517	38	355	1146
1525	232	1020	495	1282	1523	39	340	1129
1530	233	1021	498	1283	1527	40	314	1105
1535	236	1024	498	1286	1530	41	298	1050
1540	236	1025	500	1288	1534	42	260	1045
1545	240	1029	503	1289	1538	43	248	1038
1550	242	1030	508	1290	1541	44	269	1053
1555	248	1033	510	1293	1545	45	264	1053
1600	244	1031	512	1294	1549	46	326	1107
1605	246	1032	516	1296	1553	47	308	1096
1610	248	1034	516	1298	1558	48	358	1144
1615	249	1036	516	1299	1606	49	330	1114
1620	250	1037	519	1299	1612	50	342	1129

5 April 1948 Cont'd.

	LOWER BASE		UPPER BASE		FIELD INSTR.			
TIME	75	94	91	95	TIME	STA.	56	93
1629	250	1037	251	1300	1622	51	246	1033



5 APRIL 1948
CORRECTION TO LOWER BASE
OF PAULIN 56
W&T 93

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/5/48

U.B. Sta.- BM 12- Elev 297.32
L.B. Sta.- BM 10- Elev 19.75
K=Diff. of Elev = 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
30	1440	1148	1003	145	1268	1004	264	154.3	19.7	173.9
31	1445	1141	1004	137	1267	1004	263	144.5	19.7	164.2
32	1449	1109	1005	104	1269	1005	264	109.2	19.7	128.9
33	1453	1143	1007	136	1270	1007	263	143.1	19.7	162.8
34	1459	1143	1009	134	1275	1009	266	140.0	19.7	159.7
35	1501	1119	1010	109	1276	1010	266	113.6	19.7	133.3
36	1505	1101	1015	86	1278	1015	263	90.7	19.7	110.4
37	1511	1155	1017	38	1280	1017	263	145.8	19.7	165.5
38	1517	1147	1019	128	1281	1019	262	135.2	19.7	154.9
39	1523	1132	1020	112	1282	1020	262	118.5	19.7	138.2
40	1527	1108	1020	88	1282	1020	262	92.1	19.7	111.8
41	1530	1053	1021	32	1283	1021	261	34.0	19.7	53.7
42	1534	1048	1023	25	1285	1023	262	27.5	19.7	47.2
43	1538	1041	1025	16	1287	1025	262	16.9	19.7	36.6
44	1541	1056	1026	30	1288	1026	262	32.0	19.7	51.7
45	1545	1057	1029	28	1289	1029	260	29.8	19.7	49.5
46	1549	1111	1030	81	1290	1030	260	87.0	19.7	106.7
47	1553	1100	1032	68	1292	1032	260	72.5	19.7	92.2
48	1558	1148	1032	116	1294	1032	262	122.9	19.7	142.6
49	1606	1119	1032	87	1296	1032	264	91.5	19.7	111.2
50	1612	1134	1035	99	1298	1035	263	104.5	19.7	128.2
51	1622	1177	1037	140	1299	1037	262	148.2	19.7	167.9

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

PAULIN ALTIMETERS DATE:4/5/48

U.B. STA-BM 12- ELEV 297.32
L.B. STA-BM 10- ELEV 19.75
K=Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
30	1440	361	206	155	482	206	276	156.0	19.7	175.7
31	1445	352	207	145	484	207	277	145.5	19.7	165.2
32	1449	315	207	108	483	207	276	108.6	19.7	128.3
33	1454	356	210	146	485	210	275	147.6	19.7	167.3
34	1459	356	216	140	488	216	272	142.8	19.7	162.5
36	1505	309	225	84	491	225	266	87.7	19.7	107.4
35	1501	319	218	101	488	218	270	103.8	19.7	123.5
37	1511	363	227	136	492	227	265	142.6	19.7	162.3
38	1517	357	231	126	495	231	264	132.6	19.7	152.3
39	1523	343	232	111	495	232	263	117.1	19.7	136.8
40	1527	317	232	85	496	232	264	89.2	19.7	108.9
41	1530	261	230	31	498	230	268	32.1	19.7	51.8
42	1534	263	235	28	498	235	263	29.5	19.7	49.2
43	1538	251	236	15	499	236	263	15.8	19.7	35.5
44	1541	272	237	35	501	237	264	36.7	19.7	56.4
45	1545	268	240	28	503	240	263	29.5	19.7	49.2
46	1549	330	242	88	507	242	265	92.2	19.7	111.9
47	1533	312	245	67	509	245	264	70.4	19.7	90.1
48	1558	362	246	116	511	246	265	121.6	19.7	141.3
49	1606	335	246	89	516	246	270	91.6	19.7	111.3
50	1612	347	248	99	516	248	268	102.5	19.7	122.2
51	1622	391	250	141	519	250	269	145.8	19.7	165.5

7 April 1948

RENSSELAER, N.Y.

Weather-Clear, warm, slight breeze

	TIME	PAULIN			W and T		
		56	75	91	93	94	95
START	1145	100	100	100	800	800	800
END	1645	159	173	184	969	968	968

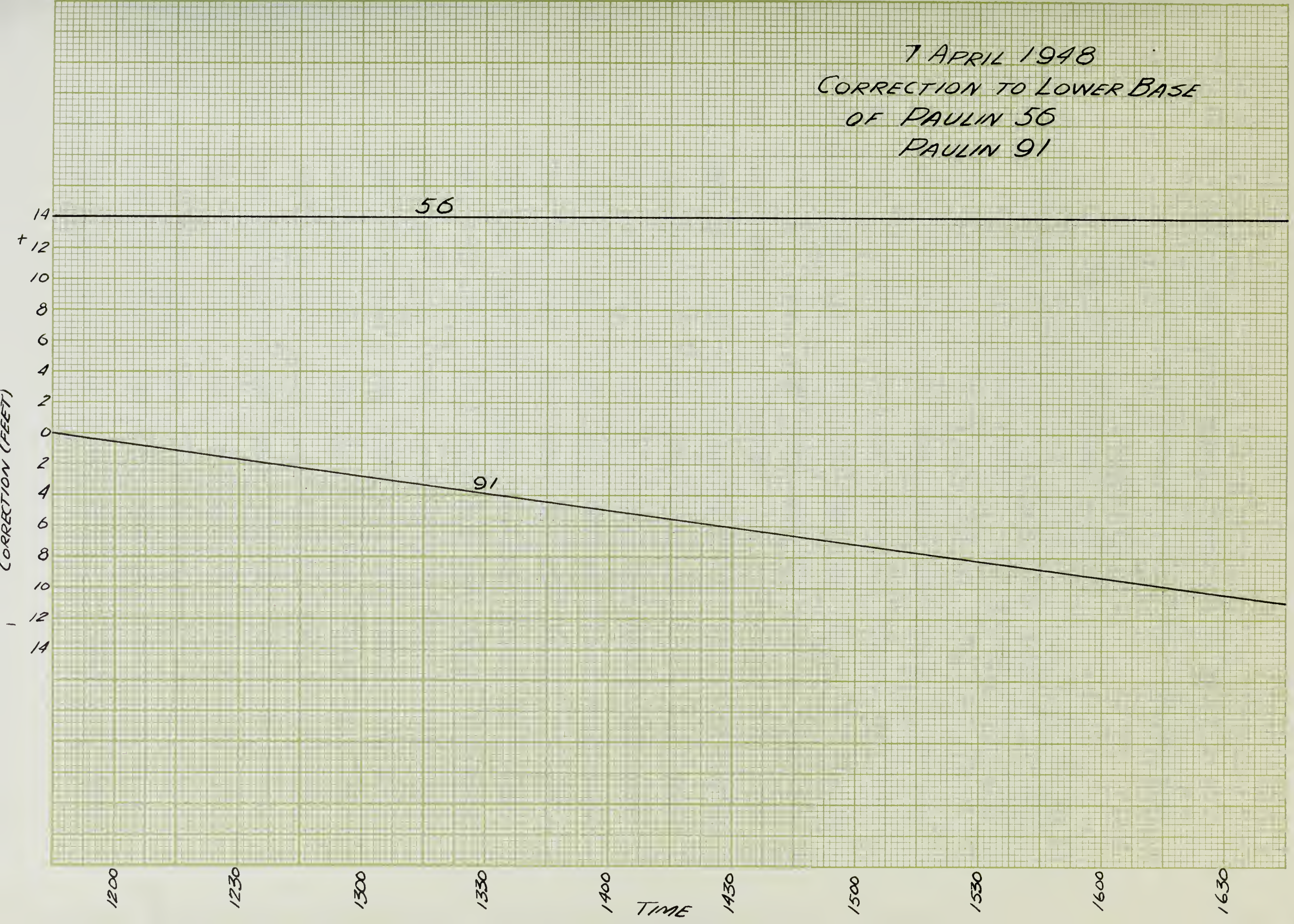
	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	75	94	91	95	TIME	STA.	56	93
1200	112	800	381	1081	1200	52	267	978
1205	106	802	390	1081	1204	53	265	979
1210	103	802	392	1083	1210	54	282	989
1215	103	807	391	1082	1213	55	279	991
1220	110	810	399	1087	1217	56	208	921
1225	115	810	403	1089	1221	57	214	927
1230	115	811	405	1091	1228	58	211	926
1235	115	811	405	1089	1233	59	210	923
1240	115	811	404	1092	1238	60	206	922
1245	115	811	405	1090	1242	61	209	923
1250	115	811	402	1087	1247	62	219	930
1255	123	816	405	1090	1252	63	230	928
1300	123	818	405	1090	1256	64	279	992
1305	127	820	407	1093	1259	65	281	998
1310	131	822	410	1096	1301	66	280	999
1315	131	821	412	1098	1305	67	285	1004
1320	131	823	409	1098	1309	68	292	1009
1325	134	829	411	1100	1314	69	284	998
1330	134	829	416	1105	1316	70	247	966
1335	143	834	416	1106	1318	71	282	999

7 April 1948 Cont'd.

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	75	94	91	95	TIME	STA.	56	93
1340	143	834	418	1108	1320	72	287	1000
1345	146	836	421	1109	1323	73	287	1002
1350	148	840	424	1114	1344	74	305	1017
1355	148	840	423	1113	1350	75	309	1021
1400	145	840	423	1112	1354	76	236	951
1405	148	841	421	1112	1358	77	235	948
1410	146	837	416	1105	1402	78	280	991
1415	144	838	415	1107	1407	79	273	986
1420	144	837	414	1106	1411	80	232	950
1425	134	833	414	1105	1415	81	237	953
1430	134	832	409	1104	1417	82	265	969
1435	136	831	407	1101	1420	83	252	967
1440	133	830	407	1101	1423	84	263	981
1515	143	841	417	1109	1425	85	270	985
1520	142	841	417	1110	1427	86	272	991
1525	145	842	421	1111	1430	87	278	997
1530	145	847	425	1112	1432	88	279	994
1535	148	849	427	1117	1434	89	290	1002
1540	152	850	429	1118	1438	90	292	1008
1545	151	854	432	1120	1515	91	283	994
1550	157	852	432	1122	1521	92	249	960
1555	160	855	435	1123	1526	93	223	938
1600	160	856	437	1125	1532	94	157	857
1605	160	857	439	1127	1536	95	162	870
1610	164	860	442	1129	1540	96	140	855

7 April 1948 Cont'd.

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	75	94	91	95	TIME	STA.	56	93
1615	165	861	445	1130	1544	97	148	860
1620	162	860	445	1129	1548	98	143	856
1625	165	860	445	1129	1552	99	161	877
1630	166	862	445	1129	1556	100	179	896
					1600	101	161	867
					1606	102	274	939
					1609	103	169	883
					1614	104	157	879
					1619	105	230	950
					1623	106	250	967



7 APRIL 1948
CORRECTION TO LOWER BASE
OF PAULIN 56
PAULIN 91

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/9/48

U.B. STA- BM 12- ELEV 297.32
L.B. STA- BM 10- ELEV 19.75
K= Diff. of Elev.= 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
52	1200	978	800	178	1081	800	281	175.6	19.7	195.3
53	1204	979	802	177	1081	802	281	174.5	19.7	194.2
54	1210	989	806	187	1083	802	281	184.5	19.7	204.2
55	1213	991	805	186	1082	805	277	186.4	19.7	206.1
56	1217	921	808	113	1084	808	276	113.6	19.7	133.3
57	1221	927	810	117	1087	810	277	117.1	19.7	136.8
58	1228	926	811	115	1090	811	279	114.3	19.7	134.0
59	1233	923	811	112	1090	811	279	111.5	19.7	131-2
60	1238	922	811	111	1091	811	280	110.0	19.7	129.7
61	1242	923	811	112	1091	811	280	110.9	19.7	130.6
62	1247	930	811	119	1089	811	278	118.7	19.7	138.4
63	1252	938	813	125	1088	813	275	126.2	19.7	145.9
64	1256	992	816	176	1090	816	284	171.9	19.7	191.6
65	1259	998	818	180	1090	818	272	183.5	19.7	203.2
66	1301	999	818	181	1090	818	272	184.5	19.7	204.2
67	1305	1004	820	184	1093	820	273	186.9	19.7	206.6
68	1309	1009	822	187	1095	822	273	190.0	19.7	209.7
69	1314	998	821	177	1098	821	277	177.1	19.7	196.8
70	1316	966	821	145	1098	821	277	145.1	19.7	164.8
71	1318	999	822	177	1098	822	276	177-9	19.7	197.6
72	1320	1000	823	177	1098	823	275	178.5	19.7	198.2
73	1323	1002	826	176	1099	826	273	178.9	19.7	198.6

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/9/48

U.B. STA- BM 12- ELEV 297.32
L.B. STA- BM 10- ELEV 19.75
K= Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
74	1344	1017	836	181	1109	836	273	183.9	19.7	203.6
75	1350	1021	840	181	1114	840	274	183.2	19.7	202.9
76	1354	951	840	111	1113	840	273	112.8	19.7	132.5
77	1358	948	840	108	1112	840	272	110.1	19.7	129.8
78	1402	991	840	151	1112	840	272	154.0	19.7	173.7
79	1407	986	839	147	1110	839	271	150.6	19.7	170.3
80	1411	950	837	113	1105	837	268	117.7	19.7	138.8
81	1415	953	838	115	1107	838	269	118.6	19.7	138.3
82	1417	969	838	131	1107	838	269	135.1	19.7	154.8
83	1420	967	837	130	1106	837	269	134.1	19.7	153.8
84	1423	981	835	146	1106	835	270	150.2	19.7	169.9
85	1425	985	833	152	1105	833	272	155.1	19.7	174.8
86	1427	991	833	158	1105	833	272	161.3	19.7	181.0
87	1430	997	832	165	1104	832	272	168.4	19.7	188.1
88	1432	994	832	162	1103	832	271	166.1	19.7	185.8
89	1434	1002	831	171	1102	831	271	185.5	19.7	195.2
90	1438	1008	830	178	1101	830	271	182.6	19.7	202.3
91	1515	994	841	153	1109	841	268	158.5	19.7	178.2
92	1521	960	841	119	1110	841	269	122.7	19.7	142.4
93	1526	938	843	95	1111	843	268	98.4	19.7	118.1
94	1532	857	848	9	1114	848	266	9.4	19.7	29.1
95	1536	870	849	21	1117	849	268	21.7	19.7	41.4

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/9/48

U.B. STA- BM 12 - ELEV 297.32
L.B. STA- BM 10 - ELEV 19.75
K= Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
96	1540	855	850	5	1118	850	268	5.2	19.7	24.9
97	1544	860	851	9	1120	851	269	9.3	19.7	29.0
98	1548	856	852	4	1121	852	269	4.1	19.7	23.8
99	1552	877	853	24	1123	853	269	24.8	19.7	44.5
100	1556	896	855	41	1123	855	268	42.4	19.7	62.1
101	1600	867	856	11	1125	826	269	11.3	19.7	31.0
102	1606	939	858	81	1127	858	269	83.4	19.7	103.1
103	1609	883	859	24	1129	859	270	24.7	19.7	44.4
104	1614	879	861	18	1130	861	269	18.6	19.7	38.3
105	1619	950	860	90	1129	860	269	92.8	19.7	112.5
106	1623	967	861	106	1129	861	268	109.8	19.7	129.5

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

PAULIN ALTIMETERS DATE:4/7/48

U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K= Diff. of Elev. =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6 XK	ELEV L.B. 8	ELEV F.S. 9=7+8
52	1200	281	112	169	388	112	276	171.2	19.7	190.9
53	1204	279	107	172	389	107	282	169.5	19.7	189.2
54	1210	296	103	193	390	103	287	186.5	19.7	206.2
55	1213	293	103	190	389	103	286	184.3	19.7	204.0
56	1217	222	105	117	392	105	287	113.2	19.7	132.9
57	1221	228	111	117	398	111	287	113.2	19.7	132.9
58	1228	225	115	110	402	115	287	106.5	19.7	126.2
59	1233	224	115	109	403	115	288	105.3	19.7	124.7
60	1238	220	115	105	402	115	287	101.5	19.7	121.2
61	1242	223	115	108	402	115	287	105.5	19.7	124.2
62	1247	233	115	118	401	115	286	114.6	19.7	134.3
63	1252	244	118	126	401	118	283	123.6	19.7	143.3
64	1256	293	123	180	402	123	289	163.2	19.7	182.9
65	1259	295	123	182	402	123	279	171.0	19.7	190.7
66	1301	294	124	170	402	124	278	169.9	19.7	189.6
67	1305	299	127	172	404	127	277	172.4	19.7	192.1
68	1309	306	130	176	406	130	276	176.9	19.7	196.6
69	1314	298	131	167	408	131	277	167.2	19.7	186.9
70	1316	261	131	130	408	131	277	130.2	19.7	149.9
71	1318	296	131	165	407	131	276	166.0	19.7	185.7
72	1320	301	131	170	406	131	275	171.5	19.7	191.2
73	1323	301	133	168	406	133	273	170.8	19.7	190.5

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

PAULIN ALTIMETERS DATE:4/7/48

U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K= Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7+8
74	1344	319	145	174	416	145	271	178.2	19.7	197.9
75	1350	323	148	175	419	148	271	179.3	19.7	199.0
76	1354	250	148	102	418	148	270	104.8	19.7	124.5
77	1358	249	146	103	418	146	272	105.2	19.7	124.9
78	1402	294	146	148	417	146	271	151.5	19.7	171.2
79	1407	287	147	140	414	147	267	145.5	19.7	165.2
80	1411	246	146	100	411	146	265	105.2	19.7	123.9
81	1415	251	144	107	409	144	265	112.1	19.7	131.8
82	1417	279	144	135	409	144	265	141.4	19.7	161.1
83	1420	266	144	122	408	144	264	128.3	19.7	148.0
84	1423	277	138	139	408	138	270	142.9	19.7	162.6
85	1425	284	134	150	408	134	274	151.9	19.7	171.6
86	1427	286	134	152	406	134	272	155.2	19.7	174.9
87	1430	292	134	158	403	134	269	163.0	19.7	182.7
88	1432	293	135	148	402	135	267	153.8	19.7	173.5
89	1434	304	136	168	401	136	265	176.0	19.7	195.7
90	1438	306	134	172	400	134	266	179.5	19.7	199.2
91	1515	297	143	154	409	143	266	160.7	19.7	180.4
92	1521	263	143	120	410	143	267	124.8	19.7	144.5
93	1526	237	145	92	414	145	269	94.8	19.7	114.5
94	1532	171	146	25	418	146	272	25.5	19.7	45.2
95	1536	176	149	27	418	149	269	27.9	19.7	47.6

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

PAULIN ALTIMETERS DATE:4/7/48

U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K= Diff. of Elev =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6 XK	ELEV L.B. 8	ELEV F.S. 9=7+8
96	1540	154	152	2	420	152	268	2.1	19.7	21.8
97	1544	162	154	8	422	154	268	8.3	19.7	28.0
98	1548	157	156	1	423	156	267	1.0	19.7	20.7
99	1552	175	158	17	424	158	266	17.7	19.7	37.4
100	1555	193	160	33	424	160	264	34.7	19.7	54.4
101	1600	175	160	15	427	160	267	15.6	19.7	35.3
102	1606	238	161	77	430	161	269	79.3	19.7	99.0
103	1609	183	163	20	431	163	268	20.7	19.7	40.4
104	1614	171	165	6	434	165	269	6.2	19.7	25.9
105	1619	244	163	81	435	163	272	82.7	19.7	102.4
106	1623	264	164	100	435	164	271	102.5	19.7	122.2

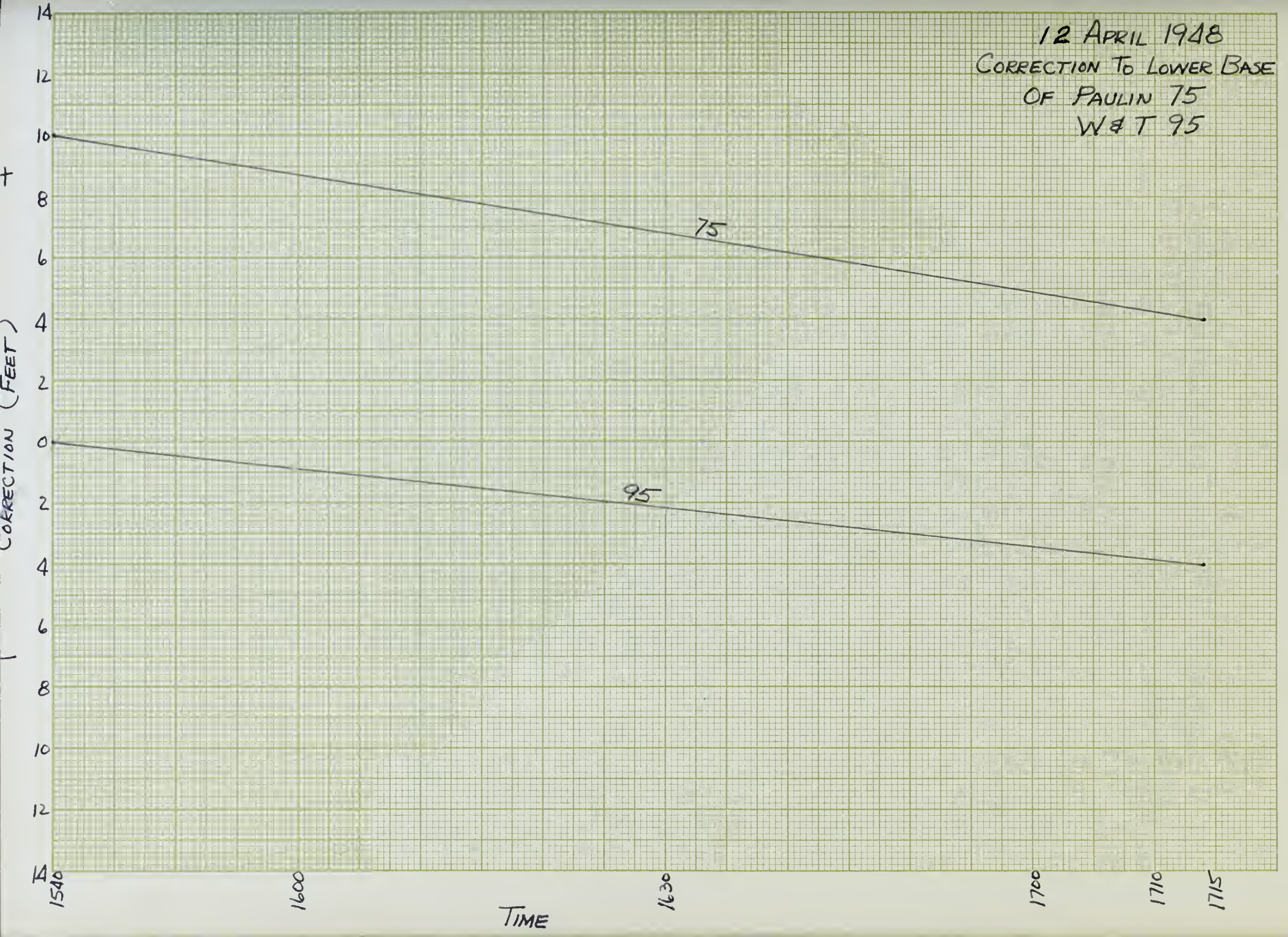
12 April 1948

RENSSELAER, N.Y.

Weather-Partly cloudy, windy.

	TIME	PAULIN			W and T		
		56	75	91	93	94	95
START	1540	300	300	300	1000	1000	1000
END	1714	265	259	264	953	952	948

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	56	95	91	94	TIME	STA.	75	93
1550	303	1002	578	1270	1553	107	410	1111
1555	304	1001	581	1270	1556	108	424	1121
1600	304	1000	581	1270	1601	109	434	1129
1605	301	994	572	1264	1605	110	405	1107
1610	303	995	572	1262	1610	111	418	1124
1615	299	989	572	1261	1615	112	409	1100
1620	298	987	568	1259	1619	113	465	1156
1625	295	983	570	1259	1626	114	443	1149
1630	291	978	560	1254	1632	115	468	1171
1635	287	974	564	1250	1638	116	473	1173
1640	276	963	555	1249	1645	117	453	1149
1645	275	961	555	1241	1650	118	443	1145
1650	278	963	557	1246	1657	119	435	1132
1655	270	955	554	1241	1701	120	397	1091
1700	269	954	552	1239				
1705	269	952	552	1239				



12 April 1948
Correction To Lower Base
Of Paulin 75
W & T 95

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/12/48

U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K = Diff. of Elev. =277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7 8
107	1553	1111	1000	111	1270	1000	270	114.1	19.7	133.8
108	1556	1121	1000	121	1270	1000	270	124.2	19.7	143.9
109	1601	1129	998	131	1269	998	271	134.0	19.7	153.7
110	1605	1107	993	114	1264	993	271	116.4	19.7	136.1
111	1610	1124	994	130	1262	994	268	134.5	19.7	154.2
112	1615	1100	987	113	1261	987	274	114.2	19.7	133.9
113	1619	1156	987	169	1259	987	272	172.7	19.7	192.4
114	1626	1149	980	169	1258	980	278	168.6	19.7	188.3
115	1632	1171	974	197	1252	974	278	196.6	19.7	216.3
116	1638	1173	965	208	1249	965	284	203.5	19.7	223.2
117	1645	1149	958	191	1241	958	283	187.5	19.7	207.2
118	1650	1145	960	185	1246	960	286	179.5	19.7	199.2
119	1657	1132	952	180	1240	952	288	173.7	19.7	193.4
120	1701	1091	950	141	1239	950	289	135.3	19.7	155.0

ALTIMETER COMPUTATION SHEET, FOR TWO BASES

PAULIN ALTIMETERS DATE:4/12/48

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L.B. STA - BM 10 - ELEV 19.75
K = Diff. of Elev = 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.-L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.-L.B. 6=4-5	QUOT X K 7=3/6XK	ELEV L.B. 8	ELEV F.S. 9=7 8
107	1553	419	304	115	580	304	276	115.5	19.7	135.2
108	1556	433	304	129	581	304	277	129.3	19.7	149.0
109	1601	443	303	140	579	303	276	140.3	19.7	160.0
110	1605	413	301	112	572	301	271	114.4	19.7	134.0
111	1610	426	303	123	572	303	269	127.0	19.7	146.7
112	1615	417	299	118	572	299	273	120.0	19.7	139.7
113	1619	473	298	175	569	298	271	179.0	19.7	198.7
114	1626	450	294	156	568	294	274	157.8	19.7	177.5
115	1632	475	289	186	562	289	273	189.2	19.7	208.9
116	1638	479	280	199	559	280	279	198.0	19.7	217.7
117	1645	459	275	184	555	275	280	182.2	19.7	201.9
118	1650	449	278	171	557	278	279	170.1	19.7	189.8
119	1657	440	270	170	553	270	283	166.3	19.7	186.0
120	1701	406	269	133	552	269	283	130.2	19.7	149.9

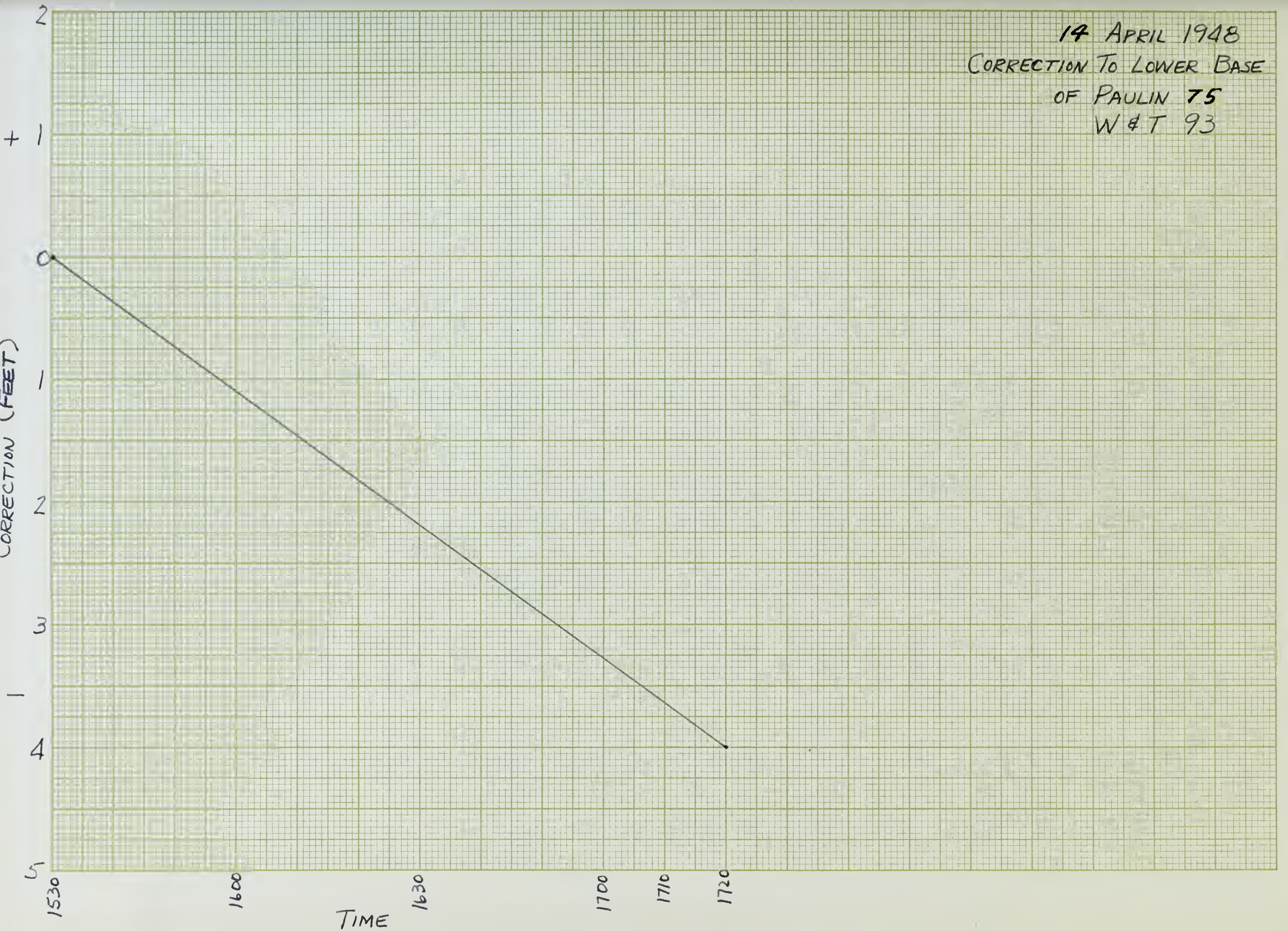
14 April 1948

RENSSELAER, N.Y.

Weather, cloudy, damp.

	TIME	PAULIN			W and T		
		56	75	91	93	94	95
START	1517	200	200	200	500	500	500
END	1720	198	202	197	498	494	493

	LOWER B.		UPPER B.		FIELD INSTR.			
TIME	56	95	91	94	TIME	STA.	75	93
1530	204	501	482	778	1530	121	234	530
1535	205	502	481	779	1538	122	281	576
1540	207	504	482	777	1549	123	351	644
1545	208	503	485	779	1555	124	311	609
1550	208	505	487	780	1607	125	400	696
1555	210	506	486	782	1615	126	401	695
1600	212	509	489	784	1630	127	353	648
1605	213	510	490	786	1638	128	361	656
1610	212	508	492	787	1647	129	288	584
1615	210	507	491	785	1654	130	263	560
1620	208	504	488	783	1700	131	213	509
1625	206	501	485	781	1708	132	232	526
1630	206	498	483	777				
1635	205	498	480	776				
1640	204	497	481	776				
1645	203	497	481	775				
1650	203	496	480	775				
1655	202	495	480	775				
1700	202	495	481	775				
1705	201	495	480	774				
1710	199	494	479	774				



14 APRIL 1948
CORRECTION TO LOWER BASE
OF PAULIN 75
W & T 93

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

WALLACE AND TIERNAN ALTIMETERS DATE:4/14/48

U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K = Diff. of Elev. = 277.57

STA.	TIME	READ F.S. 1	READ L.B. 2	F.S.- L.B. 3=1-2	READ U.B. 4	READ L.B. 5	U.B.- L.B. 6=4-5	QUOT X K 7=3/6 XK	ELEV L.B. 8	ELEV F.S. 9=7 8
121	1530	530	501	29	778	501	277	29.1	19.7	48.4
122	1538	575	503	72	778	503	275	72.8	19.7	92.5
123	1549	644	505	139	780	505	275	140.5	19.7	160.2
124	1555	608	506	105	782	506	276	105.7	19.7	125.4
125	1607	694	509	185	786	509	277	185.5	19.7	204.2
126	1615	693	507	186	785	507	278	185.9	19.7	205.6
127	1630	646	498	148	777	498	279	147.3	19.7	167.0
128	1638	653	497	156	776	497	279	155.5	19.7	175.2
129	1647	581	497	84	775	497	278	83.9	19.7	103.6
130	1657	557	495	62	775	495	280	61.4	19.7	81.1
131	1700	506	495	11	775	495	280	10.9	19.7	30.6
132	1708	522	495	27	774	494	280	26.8	19.7	46.5

ALTIMETER COMPUTATION SHEET , FOR TWO BASES

PAULIN ALTIMETERS DATE:4/14/48

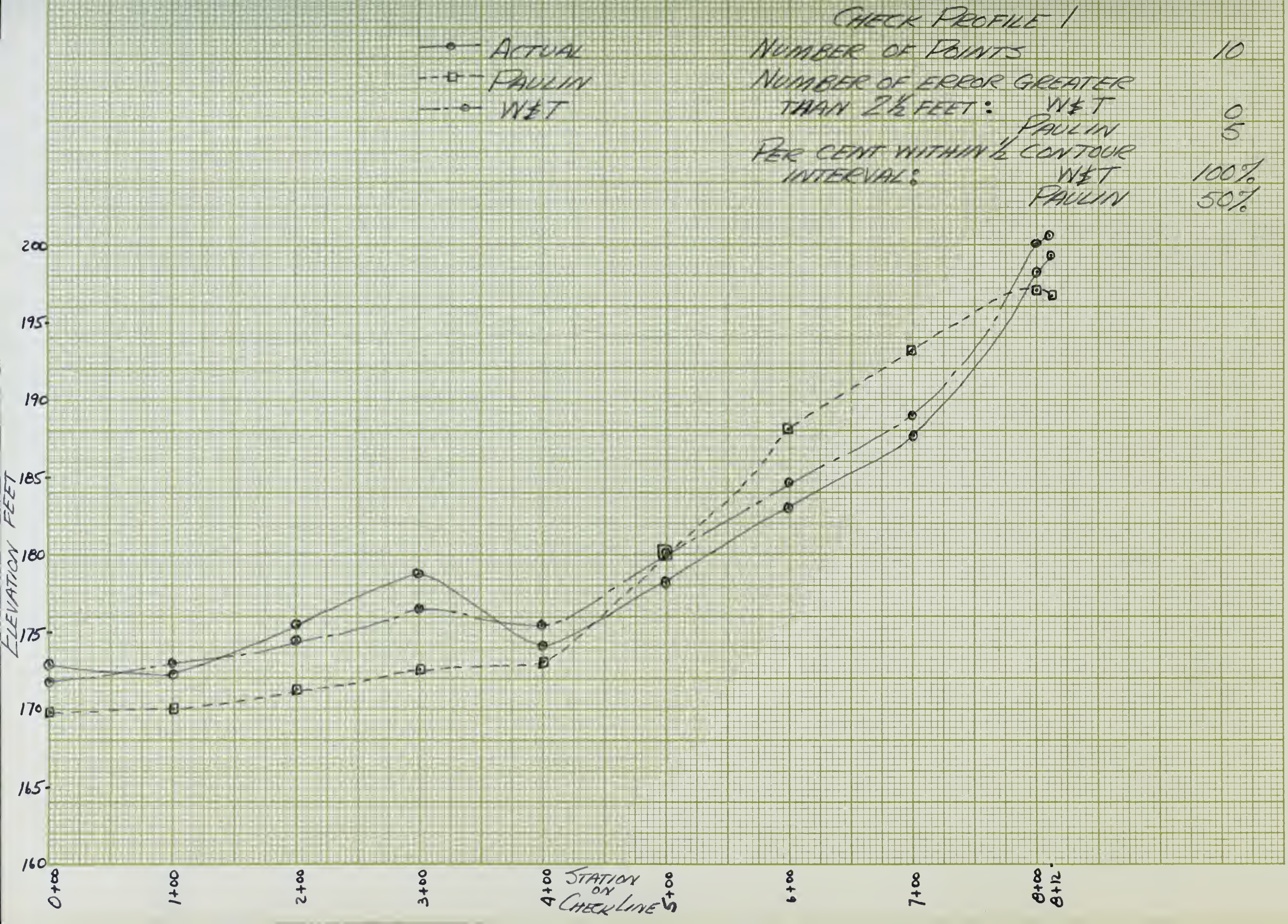
U.B. STA - BM 12 - ELEV 297.32
L.B. STA - BM 10 - ELEV 19.75
K = Diff. of Elev. =277.57

STA.	TIME	READ F.S.	READ L.B.	F.S.- L.B.	READ U.B.	READ L.B.	U.B.- L.B.	QUOT X K	ELEV L.B.	ELEV F.S.
		1	2	3=1-2	4	5	6=4-5	7=3/6XK	8	9=7 8
121	1530	234	204	30	482	204	278	29.9	19.7	49.6
122	1538	280	206	74	482	206	276	74.3	19.7	94.0
123	1549	350	208	142	487	208	279	141.1	19.7	160.8
124	1555	310	210	100	486	210	276	100.5	19.7	120.2
125	1607	398	213	185	491	213	278	184.5	19.7	204.2
126	1615	399	210	189	491	210	281	186.5	19.7	206.2
127	1630	351	206	145	483	206	277	145.1	19.7	164.8
128	1638	358	204	154	481	204	277	154.2	19.7	173.9
129	1647	285	203	82	481	203	278	81.7	19.7	101.4
130	1654	260	202	58	480	202	278	57.8	19.7	77.5
131	1700	210	202	8	481	202	279	7.9	19.7	27.6
132	1708	228	198	34	479	198	281	33.5	19.7	53.2

10 April , 1948

CHECK PROFILE NUMBER TWO

STA.	PLUS SIGHT	H.I.	MINUS SIGHT	PROFILE	ELEV.
BM 11	0.30	187.84			187.54
0-00	2.75	183.03	7.56		180.28
1-00				4.38	178.65
2-00				5.61	177.42
3-00	4.03	179.41	7.65		175.38
3-50				4.41	175.00
4-00				6.20	173.21
4-50				10.70	168.71
5-00				10.21	169.20
5-50				10.65	168.76
6-00	7.28	178.32	10.37		169.04
6-50				5.08	173.24
7-00				6.52	171.80
8-00	3.73	175.21	6.84		171.48
8-50	1.10	167.07	8.24		166.97
9-00	12.62	169.63	10.06		157-01
TP 1	3.89	172.37	1.15		168.48
9-50				7.23	165.14
10-00				6.69	165.68
10-50	0.90	160.66	12.61		159.76
11-00	0.47	151.07	10.06		150.60
11-55	1.66	141.53	11.20		139.87
12-00	1.42	134.55	8.40		133.13
12-50	4.50	126.56	12.49		122.06
13-00			7.55		119.01

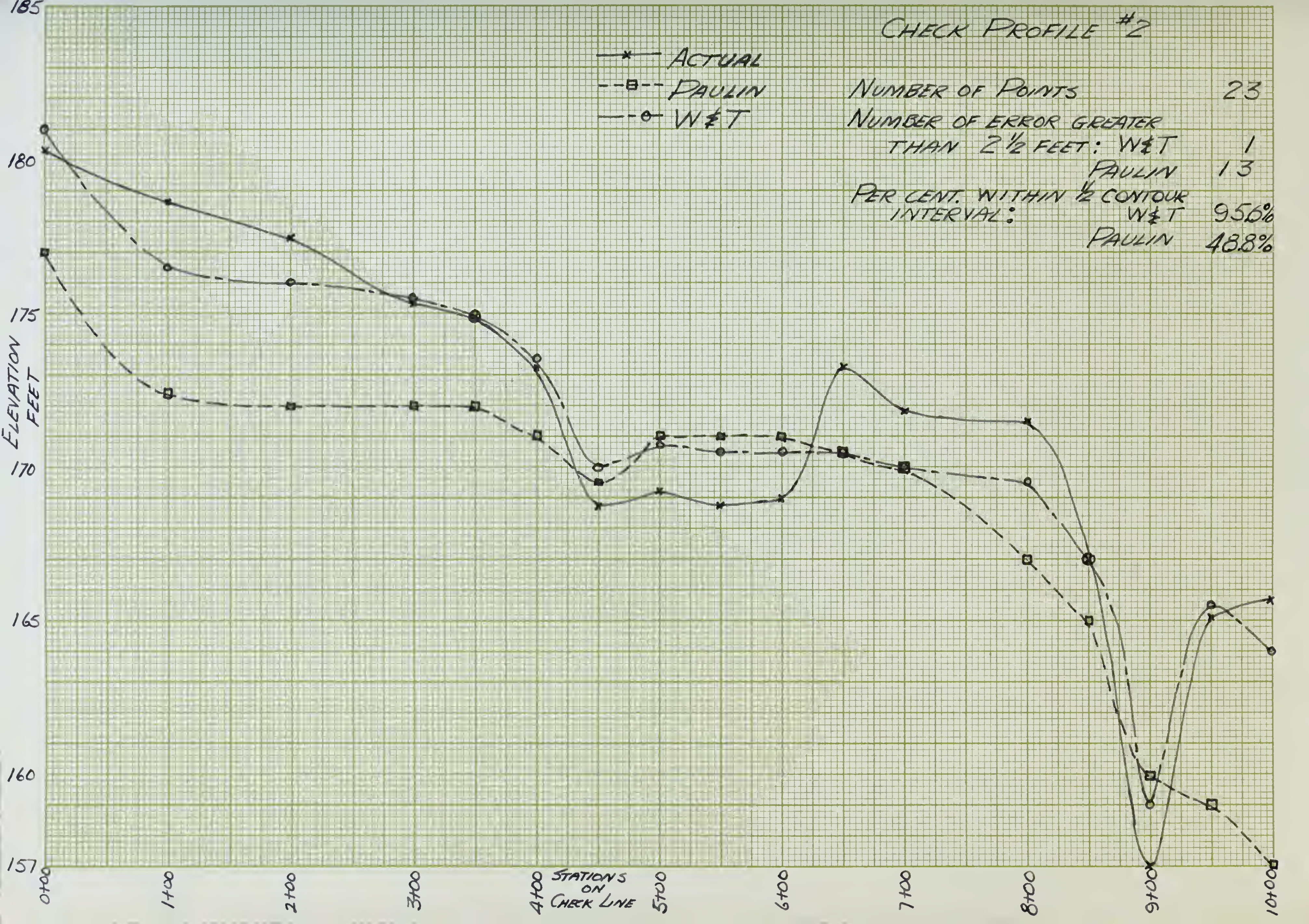


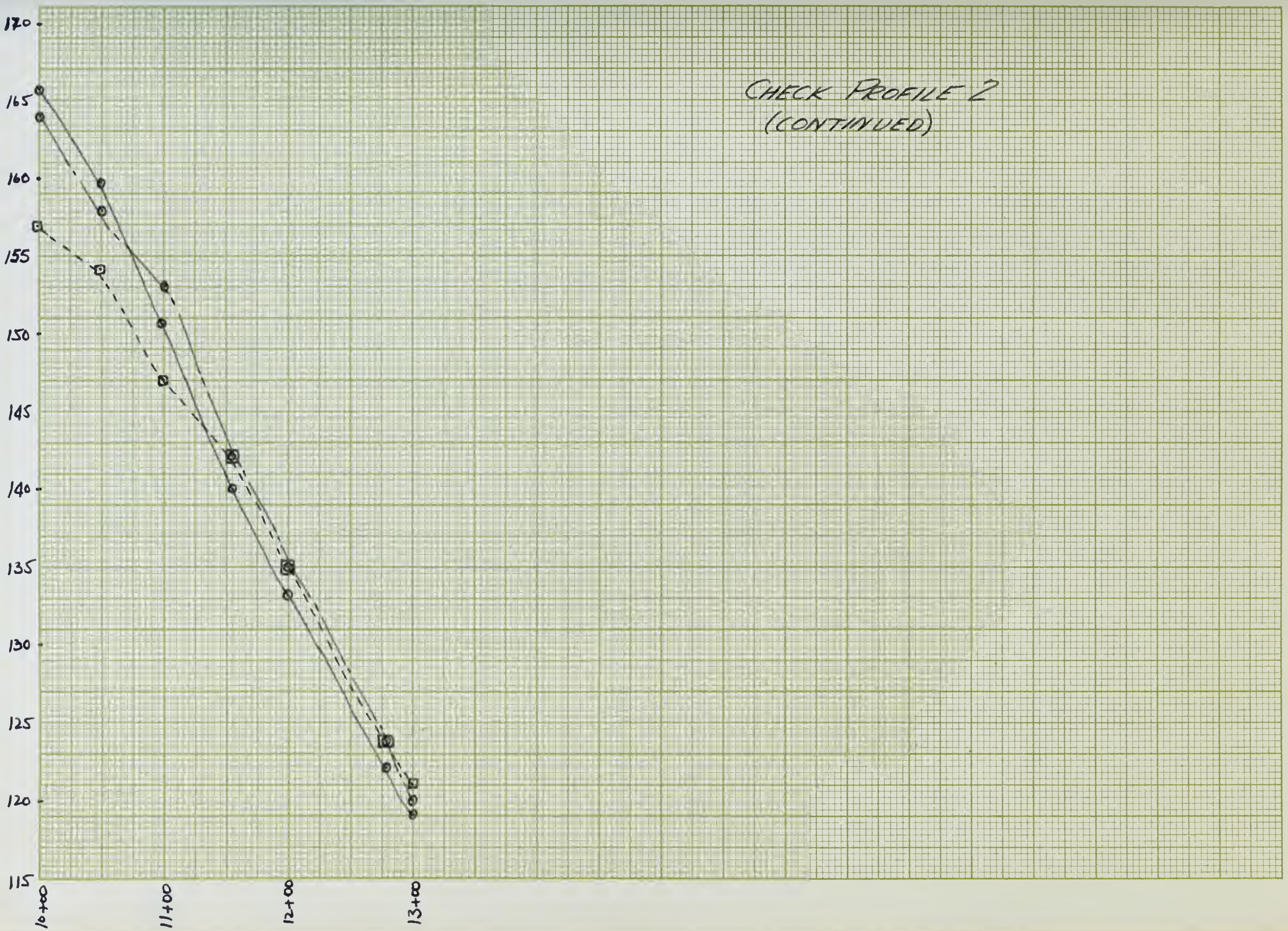
CHECK PROFILE 1

NUMBER OF POINTS 10

NUMBER OF ERROR GREATER THAN 2½ FEET:
W&T 0
PAULIN 5

PER CENT WITHIN ½ CONTOUR INTERVAL:
W&T 100%
PAULIN 50%


CHECK PROFILE #2
ACTUAL
PAULIN
W&T
NUMBER OF POINTS 23
NUMBER OF ERROR GREATER THAN 2½ FEET: W&T 1
PAULIN 13
PER CENT. WITHIN ½ CONTOUR INTERVAL: W&T 95.6%
PAULIN 48.8%
ELEVATION FEET
185
180
175
170
165
160
157
STATIONS ON CHECK LINE
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00



CHECK PROFILE 2
(CONTINUED)

CONCLUSIONS

CONCLUSIONS

From the preliminary tests and from the actual field contouring tests the following conclusions became apparent:

(1) The more rapid response of the Paulin instrument to change of pressure is offset by the large difference in reading caused by a slight movement of the balancing needle and by the fact that although the Wallace and Tiernan instruments had shown a slower response, the responses on all the Wallace and Tiernan instruments were more uniform than were the Paulins, resulting in more accurate elevation determinations.

(2) The effect of wind on the instruments makes it unwise to rely upon readings made if the wind velocity is above about 10 m.p.h..Thus wind, as well as rain and inclement weather, precludes the ability to make field observations and adds to the total time needed for completion of a job. Man hours needed for the two base method will be the same for most parts of a job. A third man is needed for field observations and a second base must be established.

(3) Speed in plotting and contouring is increased immensely if the man who carried the roving instruments over a given area also does the office work of contour plotting of this area. Since he is familiar with the area and can readily identify points on the photograph, it cannot be too highly recommended that this procedure be followed.

(4) Results are best if the area surveyed is intermediate in elevation between the two bases and if there is substantial

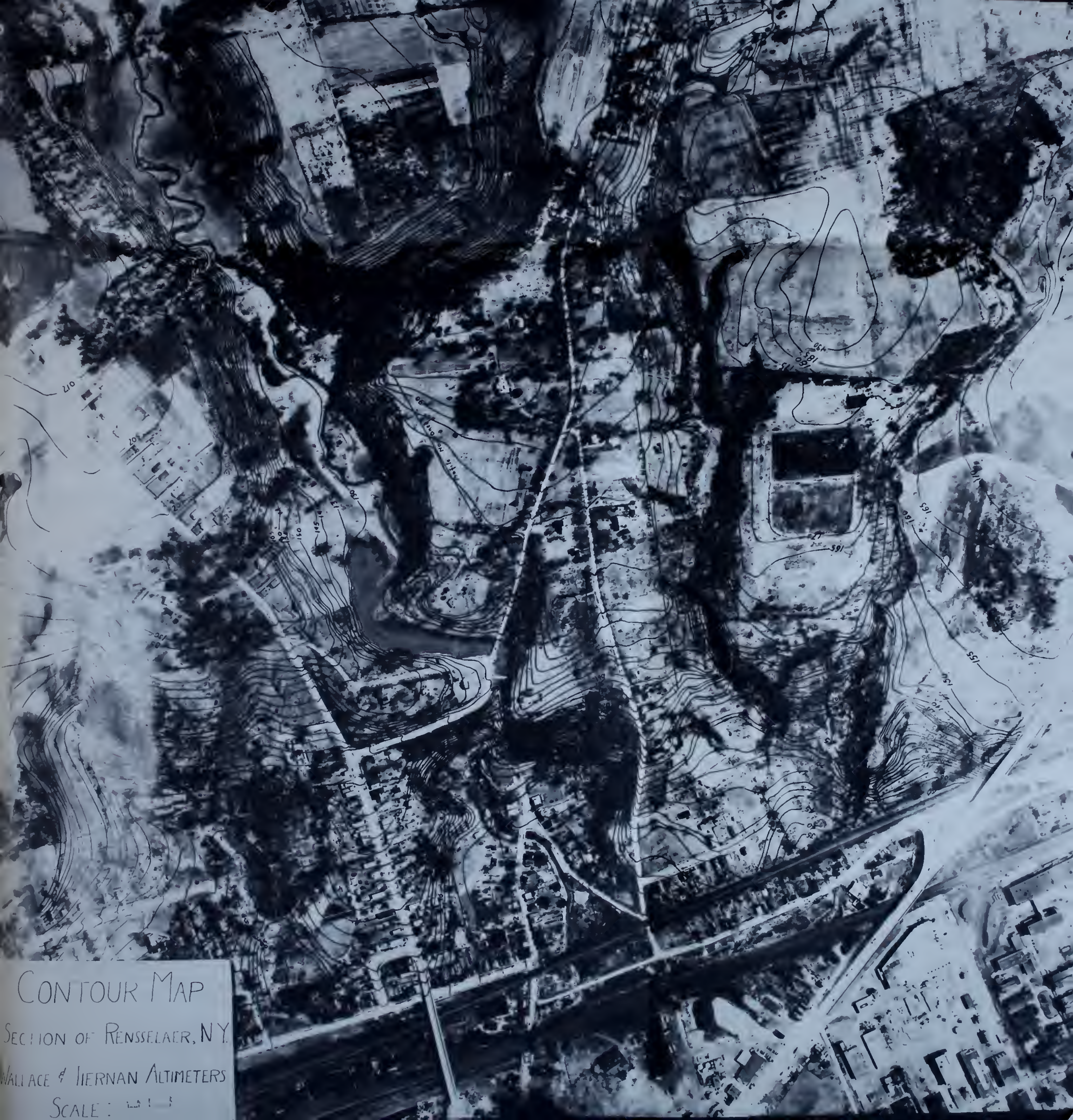
elevation difference between the bases.

(5) Wallace and Tiernan instruments are of an accuracy and reliability that recommends their use for this work. The Paulin make proved unreliable and is not recommended.

(6) The method of contouring by altimeter on aerial photographs is highly recommended for preliminary location surveys and is superior to present conventional methods in labor consumed where a large area (particularly in rugged terrain) is to be covered and where bases of known elevation are readily available, or may be easily established.

(7) The two base method is recommended over the one base method. The accuracy of the two base is somewhat better. An erratic instrument can be more easily detected and the place where the correction is to be made known. There will probably not be much difference in the overall cost of a job by the two methods.

(8) Difficulty was encountered in photostating the 27" X 27" photographs on which the contours were drawn. The woods and dark areas came out even darker on the photostats. To start with, the large photographs were darker than those used by Graves and Nicholson. The photostats were made by the same person who made those for Graves and Nicholson. Some of the reproductions being so dark as to be of little value is a factor to be considered. For the best results the original photographs must be as light as possible.

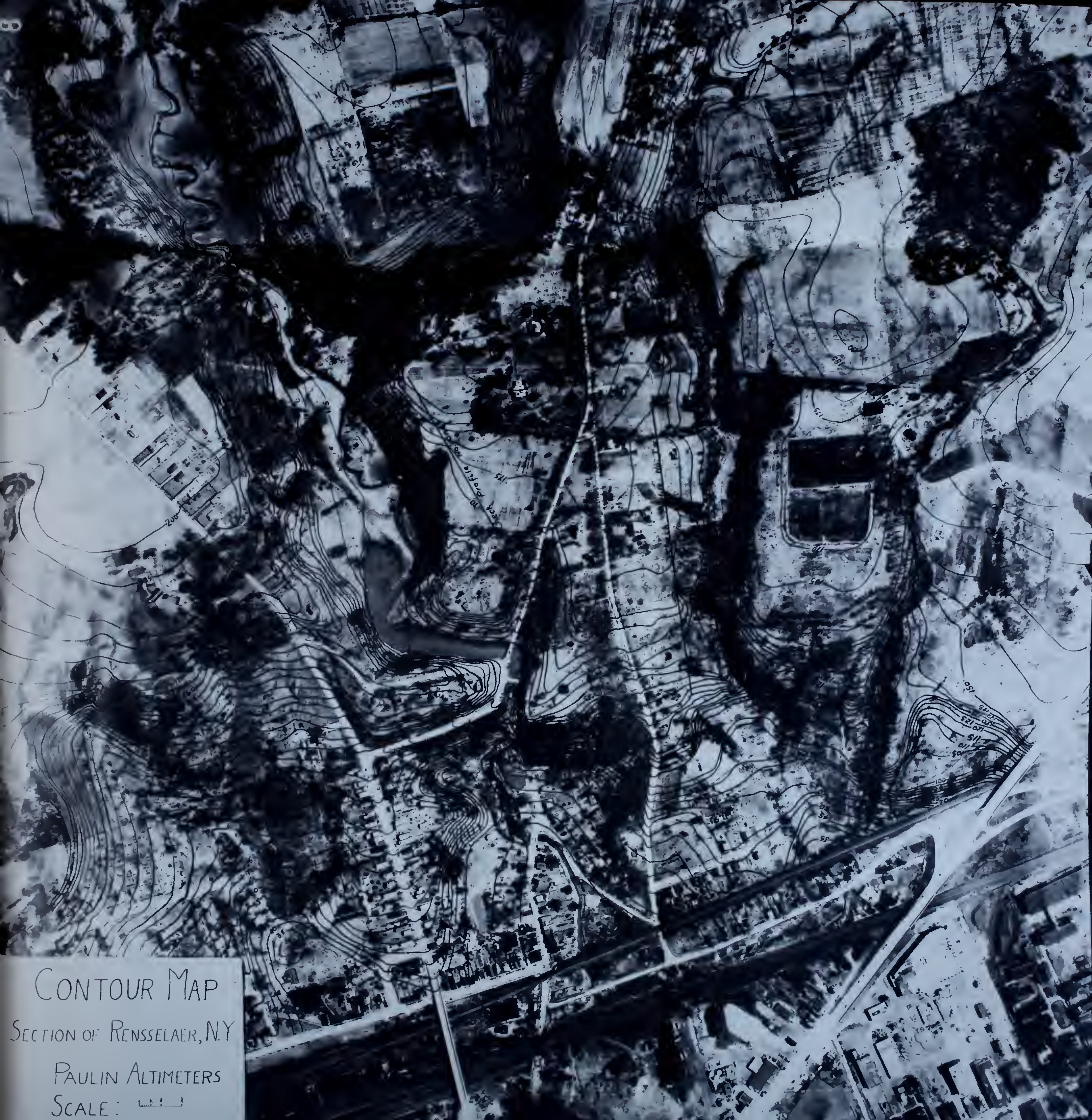


CONTOUR MAP

SECTION OF RENSSELAER, N.Y.

WALLACE & TIERNAN ALTIMETERS

SCALE:



CONTOUR MAP

SECTION OF RENSSELAER, N.Y

PAULIN ALTIMETERS

SCALE:

DATE DUE

Thesis 6893
J6

Johnson

A comparison of American Paulin system and Wallace and Tiernan altimeters, and a survey of part of the city of Rensselaer, New York by aerial photographs with the use of altimeters.

Thesis 6893
J6 Johnson
A comparison of American Paulin system and Wallace and Tiernan altimeters, and a survey of part of the city of Rensselaer, New York by aerial photographs with the use of altimeters.

thesJ6
A comparison of American Paulin system a
3 2768 002 10810 2
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